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OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR

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OF THE MAGELLANIC FUND.

SECTION 1. John Hyacinth de Magellan, in London, having in the year 1786 offered to the Society, as a donation, the sum of two hundred guineas, to be by them vested in a secure and permanent fund, to the end that the interest arising therefrom should be annually disposed of in premiums, to

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THE TUTELO TRIBE AND LANGUAGE.

By Horatio Hale.

(*Read before the American Philosophical Society, March 2, 1883.*)

The tribes of the Dakota stock, under various designations—Osages, Quappas, Kansas, Otoes, Omahas, Minitarees (or Hidatsas), Iowas, Mandans, Sioux (or Dakotas proper) and Assiniboins, have always been regarded as a people of the western prairies, whose proper home was the vast region lying west of the Mississippi, and stretching from the Arkansas River on the south to the Saskatchawan on the north. A single tribe, the Winnebagoes, who dwelt east of the Mississippi, near the western shore of Lake Michigan, were deemed to be intruders into the territory of the Algonkin nations. The fact, which has been recently ascertained, that several tribes speaking languages of the Dakota stock were found by the earliest explorers occupying the country east of the Alleghenies, along a line extending through the southern part of Virginia and the northern portion of North Carolina, nearly to the Atlantic ocean, has naturally awakened much interest. This interest will be heightened if it shall appear that not only must our ethnographical maps of North America be modified, but that a new element has been introduced into the theory of Indian migrations. Careful researches seem to show that while the language of these eastern tribes is closely allied to that of the western Dakotas, it bears evidence of being older in form. If this conclusion shall be verified, the supposition, which at first was natural, that these eastern tribes were merely offshoots of the Dakota stock, must be deemed at least improbable. The course of migration may be found to have followed the contrary direction, and the western Dakotas, like the western Algonkins, may find their parent stock in the east. As a means of solving this interesting problem, the study of the history and language of a tribe now virtually extinct assumes a peculiar scientific value. Philologists will notice, also, that in this study there is presented to them a remarkable instance of an inflected language closely allied in its vocabu-

lary and in many of its forms to dialects which are mainly agglutinative in their structure, and bear but slight traces of inflection.

In the year 1671 an exploring party under Captain Batt, leaving "the Apomatock Town," on the James River, penetrated into the mountains of Western Virginia, at a distance, by the route they traveled, of two hundred and fifty miles from their starting point. At this point they found "the Tolera Town in a very rich swamp between a breach [branch] and the main river of the Roanoke, circled about by mountains."* There are many errata in the printed narrative, and the circumstances leave no doubt that "Tolera" should be "Totera." On their way to this town the party had passed the Sapong [Sapony] town, which, according to the journal, was about one hundred and fifty miles west of the Apomatock Town, and about a hundred miles east of the "Toleras." A few years later we shall find these tribes in closer vicinity and connection.

At this period the Five Nations were at the height of their power, and in the full flush of that career of conquest which extended their empire from the Georgian Bay on the north to the Roanoke River on the south. They had destroyed the Hurons and the Eries, had crushed the Andastes (or Conestoga Indians), had reduced the Delawares to subjection, and were now brought into direct collision with the tribes of Virginia and the Carolinas. The Toteras (whom we shall henceforth know as the Tuteloes) began to feel their power. In 1686 the French missionaries had occasion to record a projected expedition of the Senecas against a people designated in the printed letter the "Tolere,"—the same misprint occurring once more in the same publication.† The traditions of the Tuteloes record long continued and destructive wars waged against them and their allies by the Iroquois, and more especially by the two western nations, the Cayugas and Senecas. To escape the incursions of their numerous and relentless enemies, they retreated further to the south and east. Here they came under the observation of a skilled explorer, John Lawson, the Surveyor-General of South Carolina. In 1701, Lawson traveled from Charleston, S. C., to Pamlico sound. In this journey he left the sea-coast at the mouth of the Santee river, and pursued a northward course into the hilly country, whence he turned eastward to Pamlico. At the Sapona river, which was the west branch of the Cape Fear or Clarendon river, he came to the Sapona town, where he was well received.‡ He there heard of the Toteros as "a neighboring nation" in the "western mountains." "At that time," he adds, "these Toteros, Saponas, and the Keyawees, three small nations, were going to live together, by which they thought they should strengthen themselves and become formidable to their enemies."

*Batt's *Journal and Relation of a New Discovery*, in N. Y. Hist. Col. Vol. iii, p. 191.

†Lambreville to Bruyas, Nov. 4, 1686, in N. Y. Hist. Col., Vol. iii, p. 484.

‡Gallatin suggests that Lawson was here in error, and that the Sapona river was a branch of the Great Pedee, which he does not mention, and some branches which he evidently mistook for tributaries of the Cape Fear river.—*Synopsis of the Indian Tribes*, p. 85.

They were then at war with the powerful and dreaded Senecas—whom Lawson styles Sinnagers. While he was at the Sapona town, some of the Toteras warriors came to visit their allies. Lawson was struck with their appearance. He describes them, in his quaint idiom, as "tall, likely men, having great plenty of buffaloes, elks and bears, with every sort of deer, amongst them, which strong food makes large, robust bodies." In another place he adds: "These five nations of the Toteros, Saponas, Keiauwees, Aconechos and Schoicories are lately come amongst us, and may contain in all about 750 men, women and children."* It is known that the Toteroes (or Tuteloes) and Saponas understood each other's speech, and it is highly probable that all the five tribes belonged to the same stock. They had doubtless fled together from southwestern Virginia before their Iroquois invaders. The position in which they had taken refuge might well have seemed to them safe, as it placed between them and their enemies the strong and warlike Tuscarora nation, which numbered then, according to Lawson's estimate, twelve hundred warriors, clustered in fifteen towns, stretching along the Neuse and Tar rivers. Yet, even behind this living rampart, the feeble confederates were not secure. Lawson was shown, near the Sapona town, the graves of seven Indians who had been lately killed by the "Sinnegars or Jennitos"—names by which Gallatin understands the Senecas and Oneidas, though as regards the latter identification there may be some question.

The noteworthy fact mentioned by Lawson, that buffaloes were found in "great plenty" in the hilly country on the head waters of the Cape Fear river, may be thought to afford a clue to the causes which account for the appearance of tribes of Dakota lineage east of the Alleghenies. The Dakotas are peculiarly a hunting race, and the buffalo is their favorite game. The fact that the Big Sandy river, which flows westward from the Alleghenies to the Ohio, and whose head waters approach those of the Cape Fear river, was anciently known as the Totteroy river, has been supposed to afford an indication that the progress of the Toteros or Tutelos, and perhaps of the buffaloes which they hunted, may be traced along its course from the Ohio valley eastward. There are evidences which seem to show that this valley was at one time the residence, or at least the hunting-ground, of tribes of the Dakota stock. Gravier (in 1700) affirms that the Ohio river was called by the Illinois and the Miamis the Akansea river, because the Akanseas formerly dwelt along it.† The Akanseas were identical with the Quappas, and have at a later day given their name to the river and State of Arkansas. Catlin found reason for believing

* Lawson's "History of Carolina;" reprinted by Strother & Marcom. Raleigh, 1860; p. 384.

† "Elle" (the Ohio) "s'appelle par les Illinois et par les Oumiamis la rivière des Akanseas, parceque les Akanseas l'habitoient autrefois."—Gravier, Relation du Voyage, p. 10. I am indebted for this and other references to my esteemed friend, Dr. J. G. Shea, whose unsurpassed knowledge of Indian history is not more admirable than the liberality with which its stores are placed at the command of his friends.

that the Mandans, another tribe of the Southern Dakota stock, formerly —and at no very distant period—resided in the valley of the Ohio. The peculiar traces in the soil which marked the foundations of their dwellings and the position of their villages were evident, he affirms, at various points along that river. It is by no means improbable that when the buffalo abounded on the Ohio, the Dakota tribes found its valley their natural home, and that they receded with it to the westward of the Mississippi. But the inference that the region west of the Mississippi was the original home of the Dakotas, and that those of that stock who dwelt on the Ohio or east of the Alleghenies were emigrants from the Western prairies, does not, by any means, follow. By the same course of reasoning we might conclude that the Aryans had their original seat in Western Europe, that the Portuguese were emigrants from Brazil, and that the English derived their origin from America. The migrations of races are not to be traced by such recent and casual vestiges. The only evidence which has real weight in any inquiry respecting migrations in prehistoric times is that of language ; and where this fails, as it sometimes does, the question must be pronounced unsoluble.

The protection which the Tuteloes had received from the Tuscaroras and their allies soon failed them. In the year 1711 a war broke out between the Tuscaroras and the Carolina settlers, which ended during the following year in the complete defeat of the Indians. After their overthrow the great body of the Tuscaroras retreated northward and joined the Iroquois, who received them into their league as the sixth nation of the confederacy. A portion, however, remained near their original home. They merely retired a short distance northward into the Virginian territory, and took up their abode in the tract which lies between the Roanoke and the Potomac rivers. Here they were allowed to remain at peace, under the protection of the Virginian government. And here they were presently joined by the Tuteloes and Saponas, with their confederates. In September, 1722, the governors of New York, Pennsylvania, and Virginia, held a conference at Albany with the chiefs of the Iroquois, to endeavor to bring about a peace between them and the southern tribes. On this occasion Governor Spotteswood, of Virginia, enumerated the tribes for which the government of his Province would undertake to engage. Among them were certain tribes which were commonly known under the name of the "Christanna Indians," a name derived from that of a fort which had been established in their neighborhood. These were "the Saponies, Ochineeches, Stenkenoaks, Meipontskys, and Toteroes," all of whom, it appears, the Iroquois were accustomed to comprehend under the name of Todirichrones.*

Some confusion and uncertainty, however, arise in consulting the colonial records of this time, from the fact that this name of Todirichrones was applied by the Iroquois to two distinct tribes, or rather confederacies, of Southern Indians, belonging to different stocks, and speaking languages

*N. Y. Hist. Col., Vol. v, p. 655 et seq.

totally dissimilar. These were, on the one hand, the Tuteloes (or Toteroes) and their allies, and, on the other, the powerful Catawba nation. The Catawbas occupied the eastern portion of the Carolinas, south of the Tuscarora nation. At the beginning of the last century they numbered several thousand souls. As late as 1743, according to Adair, they could still muster four hundred warriors. A bitter animosity existed between them and the Iroquois, leading to frequent hostilities, which the English authorities at this conference sought to repress. It was the policy of the Iroquois, from ancient times, always to yield to overtures of peace from any Indian nation. On this occasion they responded in their usual spirit. "Though there is among you," they replied to the Virginians, "a nation, the Todirichrones, against whom we have had so inveterate an enmity that we thought it could only be extinguished by their total extirpation, yet, since you desire it, we are willing to receive them into this peace, and to forget all the past."*

The Catawba language is a peculiar speech, differing widely, if not radically, both from the Dakota and from the Iroquois languages.† The only connection between the Catawbas and the Tuteloes appears to have arisen from the fact that they were neighboring, and perhaps politically allied tribes, and were alike engaged in hostilities with the Iroquois. The latter, however, seem to have confounded them all together, under the name of the tribe which lay nearest to the confederacy and was the best known to them.

One result of the peace thus established was that the Tuteloes and Saponas, after a time, determined to follow the course which had been taken by the major portion of their Tuscarora friends, and place themselves directly under the protection of the Six Nations. Moving northward across Virginia, they established themselves at Shamokin (since named Sunbury) in what is now the centre of Pennsylvania. It was a region which the Iroquois held by right of conquest, its former occupants, the Delawares and Shawanese, having been either expelled or reduced to subjection. Here, under the shadow of the great confederacy, many frag-

* N. Y. Hist. Col., Vol. v, p. 660.

† Gallatin, in his Synopsis classes the Catawba as a separate stock, distinct from the Dakota. The vocabulary which he gives seems to warrant this separation, the resemblances of words being few and of a doubtful character. On the other hand, in the first annual report of the Bureau of Ethnology connected with the Smithsonian Institution (Introduction, p. xix) the Katâba (or Catawba) is ranked among the languages of the Dakotan family. My esteemed correspondent, Mr. A. S. Gatschet, whose extensive acquaintance with Indian linguistics gives great weight to his opinion on any subject connected with this study, informs me (March 31, 1882) that this classification was conjectural and provisional, and that his subsequent researches among the few survivors of the tribe have not yet resulted in confirming it. They show certain traces of resemblance, both in the vocabulary and the syntax, but too slight and distant to make the affiliation certain. We shall have, as he remarks, "to compare more material, or more attentively that which we have, to arrive at a final result."

ments of broken tribes were now congregated—Conoys, Nanticokes, Delawares, Tuteloes, and others.

In September, 1745, the missionary, David Brainerd, visited Shamokin. He describes it in his diary as containing upwards of fifty houses and nearly three hundred persons. "They are," he says, "of three different tribes of Indians, speaking three languages wholly unintelligible to each other. About one half of its inhabitants are Delawares, the others Senekas and Tutelas."* Three years later, in the summer of 1748, an exploring party of Moravian missionaries passed through the same region. The celebrated Zeisberger, who was one of them, has left a record of their travels. From this we gather that the whole of the Tuteloes were not congregated in Shamokin. Before reaching that town, they passed through Skogari, in what is now Columbia county. In Zeisberger's biography the impression formed of this town by the travelers is expressed in brief but emphatic terms. It was "the only town on the continent inhabited by Tuteloes, a degenerate remnant of thieves and drunkards."† This disparaging description was perhaps not unmerited. Yet some regard must be paid to a fact of which the good missionary could not be aware, namely, that the Indians who are characterized in these unsavory terms belonged to a stock distinguished from the other Indians whom he knew by certain marked traits of character. Those who are familiar with the various branches of the Indian race are aware that every tribe, and still more every main stock, or ethnic family, has certain special characteristics, both physical and mental. The Mohawk differs in look and character decidedly from the Onondaga, the Delaware from the Shawanese, the Sioux from the Mandan; and between the great divisions to which these tribes belong, the differences are much more strongly marked. The Iroquois have been styled "the Romans of the West." The designation is more just than is usual in such comparisons. Indeed, the resemblance between these great conquering communities is strikingly marked. The same politic forethought in council, the same respect for laws and treaties, the same love of conquest, the same relentless determination in war, the same clemency to the utterly vanquished, a like readiness to strengthen their power by the admission of strangers to the citizenship, an equal reliance on strong fortifications, similar customs of forming outlying colonies, and of ruling subject nations by proconsular deputies, a similar admixture of aristocracy and democracy in their constitution, a like taste for agriculture, even a notable similarity in the strong and heavy mould of figure and the bold and massive features, marked the two peoples who, on widely distant theatres of action, achieved not dissimilar destinies.

Pursuing the same classical comparison, we might liken the nearest neighbors of the Iroquois, the tribes of the Algonkin stock, whose natural traits are exemplified in their renowned sachems, Powhatan, Philip of Pokano-

* Life of Brainerd, p. 167, Am. Tract Soc. edition. Quoted in the "Life of Zeisberger," by De Schweinitz, p. 71.

† Life of Zeisberger, by De Schweinitz, p. 149.

ket, Miantanomah, Pontiac, and Tecumseh, to the ingenious and versatile Greeks, capable of heroism, but incapable of political union, or of long-sustained effort. A not less notable resemblance might be found between the wild and wandering Scythians of old, and the wild and wandering tribes of the great Dakotan stock. Reckless and rapacious, untamable and fickle, fond of the chase and the fight, and no less eager for the dance and the feast, the modern Dakotas present all the traits which the Greek historians and travelers remarked in the barbarous nomads who roamed along their northern and eastern frontiers.

The Tuteloes, far from the main body of their race, and encircled by tribes of Algonkin and Iroquois lineage, showed all the distinctive characteristics of the stock to which they belonged. The tall, robust huntsmen of Lawson, chasers of the elk and the deer, had apparently degenerated, half a century later, into a "remnant of thieves and drunkards," at least as seen in the hurried view of a passing missionary. But it would seem that their red-skinned neighbors saw in them some qualities which gained their respect and liking. Five years after Zeisberger's visit, the Iroquois, who had held them hitherto under a species of tutelage, decided to admit them, together with their fellow-refugees, the Algonkin Nanticokes from the Eastern Shore of Maryland, to the full honors of the confederacy. The step received the commendation of so shrewd a judge as Colonel (afterwards Sir William) Johnson. At a great council of the Six Nations, held at Onondaga in September, 1753, Colonel Johnson congratulated the Cayugas on the resolution they had formed of "strengthening their castle" by taking in the Tedarighroones.* At about the same time a band of Delawares was received into the League. When a great council was to be convened in 1756, to confer with Colonel Johnson on the subject of the French war, wampum belts were sent to nine "nations" of the confederacy.† From this time the chiefs of the Tuteloes, as well as o the Nanticokes and the Delawares, took their seats in the Council of the League, a position which they still hold in the Canadian branch of the confederacy, though the tribes whom they represent have ceased to exist as such, and have become absorbed in the larger nations.

It would seem, however, that their removal from their lands on the Susquehanna to the proper territory of the Six Nations did not take place immediately after their reception into the League, and perhaps was never wholly completed. In an "account of the location of the Indian tribes," prepared by Sir William Johnson in November, 1763, the four small tribes of "Nanticokes, Conoys, Tutecoes [an evident misprint] and Saponeys," are bracketed together in the list as mustering in all two hundred men, and are described as "a people removed from the southward, and settled on or about the Susquehanna, on lands allotted by the Six Nations."‡

Though the Tuteloes were thus recognized as one of the nations of the

* N. Y. Hist. Col. Vol. vi, p. 811.
† Stone's Life of Sir William Johnson, Vol. i, p. 484.
‡ *Ibid.*, Vol. ii, p. 487.

confederacy, and as such kept up their distinct tribal organization, they were regarded as being in a special manner the friends and allies of the Cayugas. The latter, a tribe always noted for their kindly temper, received the new comers within their territory, and gave them a site for their town, which of course brought with it the hunting and fishing privileges necessary for their existence. The principal Cayuga villages were clustered about the lake to which the nation has given its name. South of them lay the land assigned to the Tuteloes. Their chief settlement, according to a careful observer, was on the east side of Cayuga inlet, about three miles from the south end of Cayuga lake, and two miles south of Ithaca. "The town was on the high ground south of the school-house, nearly opposite Buttermilk Falls, on the farm of James Fleming. On the Guy Johnson's map of 1771, it figures (by a slight misprint) as Todevigh-rono. It was called in the Journal of General Dearborn, Coreorgonel; in the Journal of George Grant (1779), Dehoriss-kanadia; and on a map made about the same date Kayeghtalagealat."*

The town was destroyed in 1779 by General Sullivan, in the expedition which avenged, so disastrously for the Six Nations, the ravages committed by them upon the settlements of their white neighbors. The result, as is well known, was the destruction of the ancient confederacy. Of the broken tribes, some fragments remained in their original seats, submitting to the conquerors. All the Mohawks, the greater part of the Cayugas, about half of the Onondagas, and many of the Oneidas, with a few of the Senecas and Tuscaroras, followed Brant to Canada. The British government furnished them with lands, mostly along the Grand River, in the territory which in ancient times had been conquered by the Iroquois from the people who were styled the Neutral Nation. The Tuteloes accompanied their friends the Cayugas. A place was found for them in a locality which seemed at the time attractive and desirable, but which proved most unfortunate for them. They built their town on a pleasant elevation, which stretches along the western bank of the Grand River, and still bears the name of Tutelo Heights. Under this name it now forms a suburb of the city of Brantford.

Fifty years ago, when the present city was a mere hamlet, occupied by a few venturous Indian traders and pioneers, the Tutelo cabins were scattered over these heights, having in the midst their "long-house" in which their tribal councils were held, and their festivals celebrated. They are said to have numbered then about two hundred souls. They retained apparently the reckless habits and love of enjoyment which had distinguished them in former times. Old people still remember the uproar of the dances which enlivened their council-house. Unhappily, the position of

*I am indebted for this and much other valuable information to my friend General John S. Clark, of Auburn, N. Y., who has made the location and migrations of the Indian tribes the subject of a special study. Of the above names Dehoriss kanadia is apparently a corruption of the Mohawk words *Tehoterigh kanada*, Tutelo town. The other words are probably, like most Indian names of places, descriptive designations, but are too much corrupted to be satisfactorily deciphered.

NIKONHA, THE LAST TUTELO.

IN 1870; AGED 106.

their town brought them into direct contact with the white settlements. Their frames, enfeebled by dissipation, were an easy prey to the diseases which followed in the track of the new population. In 1832, the Asiatic cholera found many victims on the Indian Reserve. The Tuteloes, in proportion to their numbers, suffered the most. The greater part of the tribe perished. Those who escaped clung to their habitations a few years longer. But the second visitation of the dreadful plague in 1848 completed the work of the first. The Tutelo nation ceased to exist. The few survivors fled from the Heights to which they have left their name, and took refuge among their Cayuga friends. By intermarriage with these allies, the small remnant was soon absorbed; and in the year 1870, only one Tutelo of the full blood was known to be living, the last survivor of the tribe of stalwart hunters and daring warriors whom Lawson encountered in Carolina a hundred and seventy years before.

This last surviving Tutelo lived among the Cayugas, and was known to them by the name of Nikonha. Okonha in the Cayuga dialect signifies mosquito. *Nikonha* was sometimes, in answer to my inquiries, rendered "mosquito," and sometimes "little," perhaps in the sense of mosquito-like. His Tutelo name was said to be Waskiteng; its meaning could not be ascertained, and it was perhaps merely a corruption of the English word mosquito. At all events, it was by the rather odd cognomen of "Old Mosquito," that he was commonly known among the whites; and he was even so designated, I believe, in the pension list, in which he had a place as having served in the war of 1812. What in common repute was deemed to be the most notable fact in regard to him was his great age. He was considered by far the oldest man on the Reserve. His age was said to exceed a century; and in confirmation of this opinion it was related that he had fought under Brant in the American war of Independence. My friend, Chief George Johnson, the government interpreter, accompanied us to the residence of the old man, a log cabin, built on a small eminence near the centre of the Reserve. His appearance, as we first saw him, basking in the sunshine on the slope before his cabin, confirmed the reports which I had heard, both of his great age and of his marked intelligence. "A wrinkled, smiling countenance, a high forehead, half-shut eyes, white hair, a scanty, stubbly beard, fingers bent with age like a bird's claws," is the description recorded in my note-book. Not only in physiognomy, but also in demeanor and character, he differed strikingly from the grave and composed Iroquois among whom he dwelt. The lively, mirthful disposition of his race survived in full force in its latest member. His replies to our inquiries were intermingled with many jocose remarks, and much good-humored laughter.

He was married to a Cayuga wife, and for many years had spoken only the language of her people. But he had not forgotten his proper speech, and readily gave us the Tutelo renderings of nearly a hundred words. At that time my only knowledge of the Tuteloes had been derived from the few notices comprised in Gallatin's Synopsis of the Indian Tribes, where

they are classed with the nations of the Huron-Iroquois stock. At the same time, the distinguished author, with the scientific caution which marked all his writings, is careful to mention that no vocabulary of the language was known. That which was now obtained showed, beyond question, that the language was totally distinct from the Huron-Iroquois tongues, and that it was closely allied to the languages of the Dacotan family.

The discovery of a tribe of Dakota lineage near the Atlantic coast was so unexpected and surprising that at first it was natural to suspect some mistake. The idea occurred that the old Tutelo might have been a Sioux captive, taken in the wars which were anciently waged between the Iroquois and the tribes of the far West. With the view of determining this point, I took the first opportunity, on my next visit to the Reserve, in October, 1870, of questioning the old man about his early history, and that of his people. His answers soon removed all doubt. He believed himself to be a hundred and six years old; and if so, his earliest recollections would go back to a time preceding by some years the Revolutionary war. At that time his people, the Tuteloes, were living in the neighborhood of two other tribes, the Saponies and the Patshenins or Botshenins. In the latter we may perhaps recognize the Ochineeches, whom Governor Spotteswood, in 1702, enumerated with the Saponies, Toteroes, and two other tribes, under the general name of Christanna Indians. The Saponies and Tuteloes, old Nikonha said, could understand one another's speech. About the language of the Patshenins, I neglected to inquire, but they were mentioned with the Saponies as a companion tribe. When the Tuteloes came to Canada with Brant, they parted with the Saponies at Niagara Falls, and he did not know what had become of them. His father's name was Onusōwa; he was a chief among the Tuteloes. His mother (who was also a Tutelo), died when he was young, and he was brought up by an uncle. He had heard from old men that the Tuteloes formerly lived on a great river beyond Washington, which city he knew by that name. In early times they were a large tribe, but had wasted away through fighting. Their war parties used to go out frequently against various enemies. The tribes they most commonly fought with were the Tuscaroras, Senecas, and Cayugas. Afterwards his tribe came to Niagara (as he expressed it), and joined the Six Nations. He knew of no Tutelo of the full blood now living, except himself.

This, with some additions to my vocabulary, was the last information which I received from old Waskiteng, or Nikonha. He died a few months later (on the 21st of February, 1871), before I had an opportunity of again visiting the Reserve. There are, however, several half-castes, children of Tutelo mothers by Iroquois fathers, who know the language, and by the native law (which traces descent through the female) are held to be Tuteloes. One of them, who sat in the council as the representative of the tribe, and who, with a conservatism worthy of the days of old Sarum, was allowed to retain his seat after his constituency had disappeared, was

accustomed to amuse his grave fellow-senators occasionally by asserting the right which each councillor possesses of addressing the council in the language of his people,—his speech, if necessity requires, being translated by an interpreter. In the case of the Tutelo chief the jest, which was duly appreciated, lay in the fact that the interpreters were dumfounded, and that the eloquence uttered in an unknown tongue had to go without reply.

From this chief, and from his aunt, an elderly dame, whose daughter was the wife of a leading Onondaga chief, I received a sufficient number of words and phrases of the language to give a good idea of its grammatical framework. Fortunately, the list of words obtained from the old Tutelo was extensive enough to afford a test of the correctness of the additional information thus procured. The vocabulary and the outlines of grammar which have been derived from these sources may, therefore, as far as they extend, be accepted as affording an authentic representation of this very interesting speech.

There is still, it should be added, some uncertainty in regard to the tribal name. So far as can be learned, the word Tutelo or Totero (which in the Iroquois dialects is variously pronounced Tiūterih or Tehōtirigh, Tehūtili, Tiūtei and Tūtie) has no meaning either in the Tutelo or the Iroquois language. It may have been originally a mere local designation, which has accompanied the tribe, as such names sometimes do, in its subsequent migrations. Both of my semi-Tutelo informants assured me that the proper national name—or the name by which the people were designated among themselves—was Yesáng or Yesáh, the last syllable having a faint nasal sound, which was sometimes barely audible. In this word we probably see the origin of the name, Nahyssan, applied by Lederer to the tribes of this stock. John Lederer was a German traveler who in May, 1670—a year before Captain Batt's expedition to the Alleghenies—undertook, at the charge of the colonial government, an exploring journey in the same direction, though not with equal success. He made, however, some interesting discoveries. Starting from the Falls of the James river, he came, after twenty days of travel, to "Sapon, a village of the Nahyssans," situate on a branch of the Roanoke river. These were, undoubtedly, the Saponas whom Captain Batt visited in the following year, the kindred and allies of the Tuteloes. Fifty miles beyond Sapon he arrived at Akenatzy, an island in the same river. "The island," he says, "though small, maintains many inhabitants, who are fixed in great security, being naturally fortified with fastnesses of mountains and water on every side."* In these Akenatzies we undoubtedly see the Aconechos of Lawson, and the Ochineeches mentioned by Governor Spotteswood. Dr. Brinton, in his well-known work on the "Myths of the New World," has pointed out, also, their identity with the Occaneeches mentioned by Beverley in his "History of Virginia," and in doing so has drawn attention to

* See "*The Discoveries of John Lederer*," reprinted by O. H. Harpel. Cincinnati, 1879, p. 17.

the very interesting facts recorded by Beverley respecting their language.*

According to this historian, the tribes of Virginia spoke languages differing so widely that natives "at a moderate distance" apart did not understand one another. They had, however, a "general language," which people of different tribes used in their intercourse with one another, precisely as the Indians of the north, according to La Hontan, used the "Algonkine," and as Latin was employed in most parts of Europe, and the Lingua Franca in the Levant. These are Beverley's illustrations. He then adds the remarkable statement: "The general language here used is that of the Occaneeches, though they have been but a small nation ever since these parts were known to the English; but in what their language may differ from that of the Algonkins I am not able to determine."† Further on he gives us the still more surprising information that this "general language" was used by the "priests and conjurors" of the different Virginian nations in performing their religious ceremonies, in the same manner (he observes) "as the Catholics of all nations do their Mass in the Latin."‡

The Akenatzies or Occaneeches would seem to have been, in some respects, the chief or leading community among the tribes of Dakotan stock who formerly inhabited Virginia. That these tribes had at one time a large and widespread population may be inferred from the simple fact that their language, like that of the widely scattered Algonkins (or Ojibways) in the northwest, became the general medium of communication for the people of different nationalities in their neighborhood. That they had some ceremonial observances (or, as Beverley terms them, "adorations and conjurations") of a peculiar and impressive cast, like those of the western Dakotas, seems evident from the circumstance that the intrusive tribes adopted this language, and probably with it some of these observances, in performing their own religious rites. We thus have a strong and unexpected confirmation of the tradition prevailing among the tribes both of the Algonkin and of the Iroquois stocks, which represents them as coming originally from the far north, and gradually overspreading the country on both sides of the Alleghanies, from the Great Lakes to the mountain fastnesses of the Cherokees. They found, it would seem, Virginia, and possibly the whole country east of the Alleghenies, from the Great Lakes to South Carolina, occupied by tribes speaking languages of the Dakotan stock. That the displacement of these tribes was a very gradual process, and that the relations between the natives and the encroaching tribes were not always hostile, may be inferred not only from the adoption of the aboriginal speech as the general means of intercourse, but also from the terms of amity on which these tribes of diverse origin, native and intrusive, were found by the English to be living together.

* See the note on page 303 of Dr Brinton's volume, 2d edition.
† History of Virginia (1st edition), p. 161.
‡ *Ibid.*, p. 171.

That the Tutelo tongue represents this "general language" of which Beverley speaks—this aboriginal Latin of Virginia—cannot be doubted. It may, therefore be deemed a language of no small historical importance. The fact that this language, which was first obscurely heard of in Virginia two hundred years ago, has been brought to light in our day on a far-off Reservation in Canada, and there learned from the lips of the latest surviving member of this ancient community, must certainly be considered one of the most singular occurrences in the history of science.

Apart from the mere historical interest of the language, its scientific value in American ethnology entitles it to a careful study. As has been already said, a comparison of its grammar and vocabulary with those of the western Dakota tongues has led to the inference that the Tutelo language was the older form of this common speech. This conclusion was briefly set forth in some remarks which I had the honor of addressing to this Society at the meeting of December 19, 1879, and is recorded in the published minutes of the meeting. Some years afterwards, and after the earlier portion of this essay was written, I had the pleasure, at the meeting of the American Association for the Advancement of Science, held in Montreal, in September, 1882, of learning from my friend, the Rev. J. Owen Dorsey, of the Smithsonian Institution, who has resided for several years as a missionary among the western Dakotas, and has made careful researches into their languages and history, that they have a distinct tradition that their ancestors formerly dwelt east of the Mississippi. In fact, the more southern Dakotas declare their tribes to be offshoots of the Winnebagoes, who till recently resided near the western shore of Lake Michigan. A comparison of their dialects, made with Mr. Dorsey's aid, fully sustains this assertion. Mere traditionary evidence, as is well known, cannot always be relied on; but when it corresponds with conclusions previously drawn from linguistic evidence, it has a weight which renders it a valuable confirmation.

The portrait of old Nikonha, an accurate photograph, will serve to show, better than any description could do, the characteristics of race which distinguished his people. The full oval outline of face, and the large features of almost European cast, were evidently not individual or family traits, as they reappear in the Tutelo half-breeds on the Reserve, who do not claim a near relationship to Nikonha. Those who are familiar with the Dakotan physiognomy will probably discover a resemblance of type between this last representative of the Virginian Tutelos and their congeners, the Sioux and Mandans of the western plains.

THE TUTELO LANGUAGE.

In the following outline of Tutelo grammar, it has been deemed advisable to bring its forms into comparison with those of the western languages of the same stock. For this purpose the Dakota and Hidatsa (or Minnetaree) languages were necessarily selected, being the only tongues of this family of which any complete account has yet been published.

For the information respecting these languages I am indebted to the Dakota Grammar and Dictionary of the Rev. S. R. Riggs (published in the Smithsonian Contributions to Knowledge) and the Hidatsa Grammar and Dictionary of Dr. Washington Matthews (published in Dr. Shea's Library of American Linguistics), both of them excellent works, of the highest scientific value.

The Alphabet.

The alphabetical method which has been followed by me in writing this language, as well as the Iroquois dialects, is based on the well-known system proposed by the Hon. John Pickering, and generally followed by American missionaries, whose experience has attested its value. The modifications suggested for the Indian languages by Professor Whitney and Major Powell have been adopted, with a few exceptions, which are due chiefly to a desire to employ no characters that are not found in any well-furnished printing-office.

The letters *b*, *d*, *h*, *k*, *l*, *m*, *n*, *p*, *s*, *t*, *w*, *y*, *z* are sounded as in English, the *s* having always its sharp sound, as in *mason*. The vowels are sounded generally as in Italian or German, with some modifications expressed by diacritical marks, thus:

a, as in *father*; in accented syllables written *ā*.
ă, like the German *a* in *Mann*.
ā, like *a* in *mat*.
â, like *a* in *fall*.
e, like *a* in *fate*; in accented syllables *ē*.
ĕ, like *e* in *met*.
i, like *i* in *machine*; in accented syllables *ī*.
ĭ, like *i* in *pin*.
o, as in *note*; in accented syllables *ō*.
ŏ, like the French *o* in *bonne*.
ô, like *o* in *not*.
u, as in *rule*, or like *oo* in *pool*; in accented syllables *ū*.
ŭ, like *u* in *pull*,
u̇, like *u* in *but*; in an accented syllable written *û*.
ü, like the French *u* in *dur*.

The diphthongs are, *ai*, like our long *i* in *pine*; *au*, like *ou* in *loud*; *âi*, like *oi* in *boil*; *iu*, like *u* in *pure*.

The consonants requiring special notice are:

ç, like *sh* in *shine*.
g, always hard, as in *go*, *get*, *give*.
j, like *z* in *azure*.
ñ, like the French nasal *n* in *an*, *bon*, *un*.
q, like the German *ch* in *Loch*, or the Spanish *j* in *joven*

The sound of the English *ch* in *chest* is represented by *tç*; the *j* and *dg* in *judge* by *dj*.

The apostrophe (') indicates a slight hiatus in the pronounciation of a word, which is often, though not always, caused by the dropping of a consonantal sound.

In general, the diacritical marks over the vowels are omitted, except in the accented syllable—that is, the syllable on which the stress of voice falls. It is understood that when a vowel (other than the *ù*) has a mark of any kind over it, the syllable in which it occurs is the accented or emphatic syllable of the word. Experience shows that the variations in the sound of a vowel in unaccented syllables, within the limits represented by the foregoing alphabet, are rarely of sufficient importance to require to be noted in taking down a new language. The only exception is in the sound marked *ù*, which occasionally has to be indicated in unaccented syllables, to distinguish it from the *u*, with which it has no similarity of sound. It is, in fact, more frequently a variation of the *a* than of any other vowel sound.

Occasionally the accented syllable is indicated by an acute accent over the vowel. This method is adopted principally when the vowel has a brief or obscure sound, as in *misáñi*, I alone, which is pronounced in a manner midway between *misāñi* and *misùñi*.

Phonology.

The Tutelo has the ordinary vowel sounds, but the distinction between *e* and *i*, and between *o* and *u* is not always clear. The word for "mother" was at one time written *henā*, and at another *ina*; the word for "he steals" was heard as *manōma* and *manūma*. In general, however, the difference of these vowels was sufficiently apparent. The obscure sound of *ù* (or in accented syllables *û*) was often heard, but when the word in which it occurred was more distinctly uttered, this sound was frequently developed into a clearer vowel. Thus *hùstōi*, arm, became *histō*; *mùstē*, spring (the season), became *mastē*; *asûñi*, white, became *asāñi*, or (losing the nasal sound) *asāi*, and so on. The use of the character *ù* (or *û*) in this language could probably be dispensed with.

The consonantal sounds which were heard were: *p* (or *b*), *t* (or *d*), *k* (or *g*), *h* (and *q*), *l*, *m*, *n*, *s*, *w* and *y*, and the nasal *ñ*. Neither *f*, *v*, nor *r* was heard, and ç (*sh*) only as a variant of *s*. Harsh combinations of consonants were rare. The harshest was that of *tsk*, as in *wagutska*, child, and this was not frequent.* Words usually end in a vowel or a liquid. A double con-

* In *wagutska* (Dakota, *koçka*), *suntka*, younger brother (Dak., *sunka*); *tçoñgo* or *tçuñki*, dog (Dak., *cuñka*) and many similar words, the *t* is apparently an adscititious sound, inserted by a mere trick of pronunciation. The Hidatsa carries this practice further, and constantly introduces the sound of *t* before the sharp *s*. The Tutelo *tsi*, foot, becomes *ătsi* in Hidatsa; *sanī*, cold, becomes *tsinia*, &c

sonant at the commencement of a word is rare. It perhaps only occurs in the combination *tç* (*tsh*) and in contractions, as *ksāñkai*, nine, for *kasāñkai*.

It is doubtful if the sonants *b*, *d* and *g* occur, except as variants of the surd consonants *p*, *t* and *k*; yet in certain words sonants were pretty constantly used. Thus in the pronouns *miñgĭtowe*, mine, *yiñgĭtowe*, thine, *iñgĭtowe*, his, the *g* was almost always sounded.

The *l* and *n* were occasionally interchanged, as in *lāni* and *nāni*, three, *letçi* and *netçi*, tongue. In general, however, the two elements seemed to be distinct. The aspirate was somewhat stronger than the English *h*, and frequently assumed the force of the German *ch* or the Spanish *j* (represented in our alphabet by *q*). Whether there were really two distinct sounds or not, could not be positively ascertained. The same word was written at one time with *h*, and at another with *q*.

The nasal *ñ* is properly a modification of the preceding vowel, and would have been more adequately rendered by a mark above or below the vowel itself; but it has seemed desirable to avoid the multiplication of such diacritical marks. This nasal is not to be confounded with the sound of *ng* in *ring*, which is a distinct consonantal element, and in the Polynesian dialects often commences a word. In the Tutelo this latter sound only occurs before a *k* or hard *g*, and is then represented by *ñ*. It is, in fact, in this position, merely the French nasal sound, modified by the palatal consonant. The nasal *ñ* is also modified by the labials *b* and *p*, before which it assumes the sound of *m*. Thus the Tutelo word for day, *nahāmbi*, or (in the construct form) *nahāmp*, is properly a modification of *nahāñbi* or *nahāñp*. In all words in which it occurs, the nasal sound was at times very faintly heard, and was occasionally so little audible that it was not noted, while at other times an *n* was heard in its place. The word for knife was written at different times *masēñi* and *masāi;* that for sky, *matōñi*, *matōi*, *mantōi*, and *mañtoi*; that for day, *nahāmbi*, *nahāmp*, *nahāñp*, and *nahāp*; that for winter, *wānē*, *wānéñi*, and *wanēi*; that for one, *nōs* and *noñs*, and so on. Whether this indistinctness of the nasal sound belongs to the language, or was a peculiarity of the individuals from whom the speech was learned, could not be satisfactorily determined.

The tendency of the language, as has been said, is to terminate every word with a vowel sound. When a monosyllable or dissyllable ends with a consonant, it is usually in a construct form, and is followed by another word grammatically related to it. Thus, *hisépi*, axe, *hisēp miñgitowe*, my axe; *monti*, a bear, *mont nosā*, one bear; *tçoñgo* (or *tçonki*), dog, *tçonk epĭsel*, good dog; *nahāmbi*, day, *nahāmp lāni*, three days.

The following brief comparative list, extracted from the more extensive vocabulary hereafter given, will show the forms which similar words take in the allied dialects, Tutelo, Dakota (or Sioux proper) and Hidatsa (or Minnetaree):

Tutelo.	Dakota.	Hidatsa.	
āti	*ate*	*ati*	father
īnā, henā, henûñ	*ina*	*hinu, hu, ikùs*	mother
tāyūtçkai	*takoçku, tçiñkçi*	*idiçi*	son
suntka	*suñka*	*tsuka*	younger brother
īh, ihī	*i*	*i*	mouth
nētçi, nētsi, lētçi	*tçeji*	*neji*	tongue
ihī	*hi*	*i, isa, hi*	tooth
lōti	*dote*	*doti, loti*	throat
isī	*siha*	*itsi*	foot
wasūt	*nasu*	*tsuata*	brain
wāyī, wayīi	*we*	*idi*	blood
atī	*tipi*	*ati*	house
maséñi, masāi	*isañ, miñna*	*maetsi*	knife
mī	*wi*	*midi*	sun (or moon)
nihāmpi, nihāñpi	*añpetu*	*mape*	day
manī	*mini*	*mini*	water
amāñi, amāi	*maka*	*ama*	land
tcūñki, tçoñgo	*çunka*	*maçuka*	dog
wānéñi, wānēi	*wani*	*mana*	winter
tañi	*ptañ*	*mata,*	autumn
asáñi, asāi, aséi	*sañ*	*atùki, ohùki*	white
asépi	*sapa*	*çipi*	black
sīi, wāsi	*zi*	*tsi, tsidi*	yellow
tē	*ta*	*te*	dead
sani	*sni*	*tsinia*	cold
nosāi, noñç	*wantça, wantçi*	*nuéts, luétsa*	one
nombāi	*noñpa*	*nopa*	two
nāni, lāni	*yamni*	*dámi, lawi*	three
topai	*topa*	*topa*	four
kisāhai	*zaptañ*	*kihu*	five
akáspe	*çakpe*	*akama, akawa*	six
sāgomink	*çakowiñ*	*sapua*	seven
luta	*yuta, wota*	*duti*	to eat
howa	*u, uwa*	*hu*	to come
kitei	*watçi*	*kidiçi*	to dance
mahanañka	*yañka, nañka*	*naka*	to sit, remain
ktéwa, kitésel	*kte*	*kitahé*	to kill

It must be borne in mind that the sounds of *m*, *b*, and *w* are interchangeable in the Hidatsa, and that *d*, *l*, *n*, and *r* are also interchangeable. A similar confusion or interchange of these elements is to some extent apparent in the Dakota and the Tutelo languages. Taking this fact into consideration, the similarity or rather identity of such words as *mi* in Tutelo and *wi* in Dakota, meaning "sun," and *loti* in Tutelo, *dote* in Dakota, and *dote* or *lote* in Hidatsa, meaning "brain," becomes apparent.

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The nasal sounds, which are so common in the Dakota and the Tutelo, are wanting in the Hidatsa, while the *s* of the two former languages frequently becomes *ts* in Hidatsa. These dialectical peculiarities explain the difference between the words for younger brother, *suntka*, Tu., *suñka*, Da., *tsuka*, Hi., between *isi*, foot, Tu., and *itsi*, Hi., between *maseñi*, knife, Tu., and *maetsi*, Hi. It will be noticed that the words in Tutelo are frequently longer and fuller in sound than the corresponding words in the other languages, as though they were nearer the original forms from which the words in the various Dakota tongues were derived.

Grammatical Forms.

As is usually the case with allied tongues, the grammatical resemblances of the languages of this stock are much more striking and instructive than those which appear in the mere comparison of isolated words.

Substantives and Adjectives.

The Tutelo, like the Dakota and the Hidatsa, has no inflection of the substantive to indicate the plural number; but in both the Tutelo and the Dakota, the plural of adjectives is frequently expressed by what may be termed a natural inflection, namely, by a reduplication. In the Dakota, according to Mr. Riggs, the initial syllable is sometimes reduplicated, as *ksapa*, wise, pl. *ksaksapa; tañka*, great, pl. *tañktañka;* sometimes it is the last syllable, as *waçté*, good, pl. *waçtéçte;* and occasionally it is a middle syllable, as, *tañkiñyañ*, great, pl. *tañkiñkiñyañ*.

Sometimes the adjective in Dakota takes the suffix *pi*, which makes the plural form of the verb, as *waçté*, good *witçasta waçtépi*, good men, *i. e.*, they are good men.

Similar forms exist in the Tutelo. The adjective, or some part of it, is reduplicated in the plural, and at the same time a verbal suffix is frequently if not always added, thus; *ati api*, good house, pl. *ati apipisel*, good houses (those are good houses); *ati itáñi*, large house, pl. *ati itañtáñsel; ati okayēke*, bad house, pl. *ati okayeyēkesel; ati asáñ*, white house, pl. *ati asañsáñsel*. Occasionally the reduplication takes a peculiar form, as in *ati kutska*, small house, pl. *ati kotskutskaisel*. In one instance the plural differs totally from the singular; *ati sui*, long house, pl. *ati yumpañkatskaisel*.

The plural verbal termination is frequently used without the reduplication; as, *wahtáke bi* (or *pi*), good man, *wahtáke biwa* (or *bise*), he is a good man; pl. *wahtáke bihla* (or *bihlése*), they are good men. So *tçoñge bise*, good dog (or, it is a good dog), pl. *tcoñge bihlése*.

The plural form by reduplication does not appear to exist in the Hidatsa.

The Rev. J. Owen Dorsey, who has made a special study of the western Dakota languages, finds in the Omaha (or Dhegiha) dialect a peculiar meaning given to this reduplicate plural of adjectives. The following ex-

amples will illustrate this signification. *Jiñgā*, small, becomes in the reduplicate form *jiñjiñga*, which refers to small objects of different kinds or sizes. *Sagī*, firm, fast, hard, makes *sāsagi* or *sagīyi*, which is employed as in the following example: *wēdhihide sagīyihnan kañbdha*, I wish tools that are hard, and of different kinds, them only. Here the suffix *hnān* expresses the meaning of "only;" the reduplication of the adjective gives the sense expressed by the words "of different kinds." *Sābe*, black, makes *sāsabe*, black here and there. *Gdhejē*, spotted, becomes *gdhejāja* spotted in many places. *Pīaji*, bad, makes *pīpiaji*, as in *uçkañ pipiaji*, different bad deeds. *Nūjiñga* (apparently a compound or derivative form, from *jiñgā*, small), means "boy," *i. e.*, small man; *nūjiñjiñga*, boys of different sizes and ages.* It would seem from these examples that in this language the reduplication expresses primarily the idea of variety, from which that of plurality in many cases follows. This meaning is not indicated by Mr. Riggs in his Dakota grammar, and it was not detected by me in the Tutelo, but it is not impossible that it actually exists in both languages. It is deserving of notice that while no inflection of the noun is found in the Iroquois to express plurality, this meaning is indicated in the adjective by the addition of *s*, or *hoñs*, affixed to the adjective when it is combined with the noun. Thus from *kanóñsa*, house, and *uīyo*, handsome, we have *konoñsīyo*, handsome house, pl. *kanoñsīyos*, handsome houses. So *kareñnaksen*, bad song, pl. *kareñnaksens*, bad songs; *kanākares*, long pole, pl. *kanakarēshoñs*, long poles.

It is also remarkable that the peculiar mode of forming the plural, both of substantives and of adjectives, by reduplication of the first syllable or portion of the word, is found in several Indian languages spoken west of the Rocky Mountains, and belonging to families entirely distinct from one another, and from the Dakota. Thus in the Selish language we have *lùáus*, father, pl. *lùlùáus; tána*, ear, pl. *tùntána; skùltamiqo*, man, pl. *skùlkùltamiqo; qáest*, good, pl. *qùsqáest*. In the Sahaptin, *pītin*, girl, pl. *pipītin; tāhs*, good, pl. *titāhs*. In the Kizh language, *woróit*, man, pl. *wororōt; tçinni*, small, pl. *tçitçinni*.† This has been termed, and certainly seems, a natural mode of forming the plural. It is therefore somewhat surprising to find it restricted in America to a comparatively small group of linguistic families. It is still more noteworthy that in the Polynesian dialects, which in their general characteristics differ so widely from the Indian languages, this same method of forming the plural is found, but confined, as in the Dakota tongues, to the adjective; thus we have *laau tele*, large tree, pl. *laau tetele*, large trees; *taata maitai*, good man, pl. *taata maitatai*, good men; *mahaki*, sick, pl. *mahamahaki*, sick (persons).‡ This is a subject in linguistic science which merits further investigation.

* I am indebted to Mr. Dorsey's letters for this and much other information of great interest respecting the western languages of the Dakota stock, forming part of his extensive work, which we may hope will soon be published.

† Ethnography and Philology of the U. S. Exploring Expedition under Chas. Wilkes, pp. 534, et seq.

‡ *Ibid.*, p. 244.

Numerals.

The near resemblance of the first seven numerals in the Tutelo, Dakota, and Hidatsa is sufficiently shown in the vocabulary. The manner in which the compound numbers are formed is also similar in the three languages. In the Dakota *ake*, again, is prefixed to the simple numerals to form the numbers above ten, as *ake wañjidañ*, eleven; *ake noñpa*, twelve. In the Tutelo the same word (usually softened to *age*) is used, as *agenōsai*, eleven; *agenombai*, twelve. In the Hidatsa *aqpi* (or *ahpi*), signifying a part or division, is employed, as *aqpi-duutsa*, eleven; *aqpi-dopa*, twelve.

In Dakota, *wiktçemna*, ten, and *noñpa*, two, form *wiktçemna noñpa*, twenty. In Tutelo the form is the same; *putçka nomba*, tens-two. In Hidatsa it is similar, but the position of the words is reversed, twenty being *dopá-pitika*, two tens.

The ordinal numbers, after the first, are formed in all three languages by prefixing *i* or *ei* to the cardinal numbers, as in Dakota, *inoñpa*, second; *iyamni*, third; *itopa*, fourth. In Hidatsa, *idopa*, second; *idani*, third; *itopa*, fourth. In Tutelo I received *einombai*, twice; *eināni*, thrice; *eintōpai*, four times. This rendering was given by the interpreter, but the true meaning was probably the same as in the Dakota and Hidatsa. The word for "first" is peculiar in all three languages; in Dakota, *tokaheya*, in Hidatsa, *itsika*, in Tutelo, *etāhni*.

In the Tutelo the numerals appear to have different forms; or perhaps, more accurately speaking, different terminations, according to the context in which they are used. The following are examples of these forms, the first or abridged form being apparently used in ordinary counting, and the others when the numerals are employed in conjunction with other words. The various pronunciations of my different informants—and sometimes of the same informant at different times—are also shown in these examples.

	Separate.	Construct.	Variations.
1	*nōñs, nōs*	*nosāi, noñsāi*	*nosēñ, nuseñ, noñsai, noñsa, nōsāñ, nōsāh, noñsah*
2	*nomp*	*nombāi*	*numbāi, nomba, nūmba, noñmbai, noñpa, nōmbāh, nombaq*
3	*lāt, nān*	*nāni*	*lāni, lānih, lāniq*
4	*tōp*	*topāi*	*toba, topah*
5	*kisē, kisáñ*	*kisāhai*	*kisāháñi*
6	*agās* or *akás, akāsp*	*akáspē*	*akaspé, akāspei, agespeq*
7	*sāgóm*	*sagomēi*	*sagōmi, sāgōmiq, sagomiñk*
8	*ƥālán*	*palāni*	*palāniq*
9	*sā* or *sāñ, ksañk*	*ksāhkai*	*kasankai, ksākai*
10	*putçk, lūtçk'*	*putskai*	*butçkai, putskáñi, putskāñ*
11	*āgenōsai*		*aginosai, akinosai*

	Separate.	Construct Forms and Variations.
12	*agenomba*	*aginombai, akinombai*
13	*agelani*	*agilāli, akilāni*
14	*agetoba*	*akitōpa*
15	*agegisai*	*akikisāhai*
16	*agegāspe*	*akikaspei*
17	*agesagōmi*	*akisagomei*
18	*agepalāni*	*akipalali*
19	*agekesañka*	*akikasañkai*
20	*putska nomba, putçka nombai*	*putska nombai*
30	*putska nani*	*putçka lani*
40	*putska tobai*	
100	*ukenī nōsā*	*okenī*
1000	*ukenī putskai*	

The numeral follows the noun which it qualifies. If the noun terminates in a vowel not accented, the vowel is usually dropped, while the numeral assumes its constuctor or lengthened form, and is sometimes closed with a strong aspirate. Thus, from *miháñi*, woman, we have *mihañ nosā* or *mihañ noñsāi*, one woman; *mihañ nombaq*, two women; *mihañ laniq*, three women, &c. From *tçoñgo* or *tçoñki*, dog, *tcoñk nosāh*, one dog; *tcoñk nombaq*, two dogs. From *monti*, bear, *mont nōsāh*, one bear; *mont nombah*, two bears. From *nahambi*, day, *nahámp nosāh*, one day, *nahamp nombai*, two days; *nahamp lāniq*, three days, &c. It will be seen that the dropping of the final vowel of the noun has the effect of giving a sharper sound to the preceding consonant. When the final vowel is accented, no change takes place in the noun; thus *atī*, house; *atī noñsai*, one house; *atī noñbai*, two houses; *atī laniq*, three houses, &c.

No such difference between the simple and the construct forms of the numerals appears to exist either in the Dakota or in the Hidatsa. This is one evidence, among others, of the greater wealth of inflections which characterizes the Tutelo language.

Pronouns.

There are in the Tutelo, as in the Dakota, two classes of pronouns, the separate pronouns, and the affixed or incorporated pronouns. The former, however, are rarely used, except for the purpose of emphasis. In the Dakota the separate pronouns are *miye* or *miç*, I, *niye*, or *niç*, thou or ye, *iye*, or *iç*, he or they, and *uñkiye* or *uñkie*, we. In the Tutelo, *mīm* signifies I or we, *yīm*, thou or ye, *im*, he or they, which was sometimes lengthened to *imahēse*. A still more emphatic form is made with the termination *sái* or *sáñi*, giving the sense of "alone," or rather perhaps

"self," for which meaning the Dakota employs the separate pronouns already given, while the Hidatsa has a special form; thus:

Tutelo.	Dakota.	Hidatsa.	
misāi or *misáñi*	*miye* (*miç*)	*miqki*	I myself (or I alone)
yisāi, or *yesáñi*	*niye* (*niç*)	*niqki*	thou
esāi, *isāi* or *isáñi*	*iye* (*iç*)	*iqki*	he
maesāi or *maesáñi*	*uñkiye* (*uñkiç*)	*midoki*	we

The Dakota *uñkiye* is said to be properly a dual form. The Tutelo apparently, like the Hidatsa, has no dual.

The affixed or incorporated pronouns have in the Tutelo, as in the Dakota and Hidatsa, two forms, nominative and objective. These forms in the three languages are very similar:

Tutelo.	Dakota.	Hidatsa.	
	Nominative.		
ma, wa	*wa, we*	*ma*	I
ya, ye	*ya, ye*	*da* (*na*)	thou
mae, mai, wae, wai, man, mañk,	*uñ*		we
	Objective.		
mi, wi	*ma, mi*	*mi*	me
yi, hi	*ni*	*di* (*ni*)	thee
e, ei, i		*i*	him
mae, mai, wae, wai	*uñ*		us

The objective forms are also used in all these languages as possessive pronouns, and they are affixed as nominatives to neuter or adjective verbs, in the first and second persons. The third personal pronoun is not expressed in the verb, at least in the singular number. In the plural the Tutelo indicates this pronoun by an inflection, both in the nominative and the objective. Thus *hahēwa*, he says, *hahéhla*, they say; *minēwa*, I see him, *minéhla*, I see them.

The Hidatsa makes no distinction between the singular and the plural of the possessive pronouns. *Mi* signifies both my and our, *di*, they and your, and *i*, his and their. The Dakota distinguishes the plural by adding the particle *pi* to the noun. The Tutelo adds *pui* to the noun in the second person, and sometimes *lei* or *kai* to the third. With nouns signifying relationship, the Dakota indicates the possessive pronoun of the third person by adding *ku* to the noun. The Tutelo sometimes adds *ka* or *kai* not only in this person, but in the first and third persons, as shown in the following example:

Dakota.	Tutelo.		
suñka	*súntka*		younger brother
misuñka	*wisúntk*	my	" "
yisuñka	*yisúntk*	thy	" "
suñkaku	*esúntka* or *esúntkai*	his	" "
uñkisuñkapi	*maisúñtkai*	our	" "
nisuñkapi	*yisúñtkapui*	your	" "
suñkapi	*eisúñtkai*	their	" "

In the Tutelo an *e* is sometimes prefixed to the possessive pronouns, as in *ati*, house, which makes

ewāti	my house	*emānti*	our house
eyāti	thy "	*eyātipūi*	your "
cāti	his "	*cāti-lei*	their "

In this case the final vowel of the pronouns *wi* and *yi* is elided before the initial *a* of the noun. So in *minēwa*, I see him, the vowel of the prefixed pronoun *ma*, I, is elided before the vowel of the verb *inēwa*, to see. Some other euphonic changes of the possessive pronoun in the Tutelo are shown in the following example:

Dakota.	Tutelo.	
pa	*pasūi*,	head
mapa	*mimpasūi*,	my head
nipa	*yiñpasūi*,	thy "
pa	*epasūi*,	his "
uñpapi	*emañkpasūi*,	our heads
nipapi	*eyiñkpasūpui*	your "
papi	*epasūi-lei*	their "

In Tutelo, *tāt'*, my father, is an anomalous form, used instead of *māt'*, or *emāt'*. With the other affixes the word becomes *yāt'* (or *itāti*), thy father, *eāt'*, his father (or their father), *emaāt'*, our father, *eyātpui*, your father.

A good example of the use of the prefixed personal pronouns in the Tutelo is shown in the word for son. There were slight differences in the forms received from two of my informants, as here given:

witéka	*witékai*	my son
yitēka	*yitékai*	thy son
etéka	*etékai*	his son
mañktéka	*emañktékai*	our son
yitékabūi	*yitékabūi*	your son
etéka	*etekahlēi*	their son

Minēk', my uncle (in Dakota *midekçi*) is thus varied: *Yinēk'*, thy uncle (Dak. *nídekçi*), *einēk'*, his uncle (Dak. *deçitku*), *emainek*, our uncle, *einēkpui*, your uncle, *einek'* or *einek'-lei*, their uncle.

In the word for brother, *iñginumbāi* (or *iñkinumbāi*), the possessive pronouns are inserted after the first syllable, and in this instance they are used in the nominative form:

iñwaginumbāi	my brother	*maiiñginumbāi*	our brother
iñyagnumbāi	thy brother	*iñyaginumbabūi*	your brother
ingiginumbāi	his brother	*iñgiginumbāi*	their brother

The Dakota and Hidatsa have lengthened forms of the personal pronouns to indicate property in things, or "transferable possession." These are in the former, *mita*, my, *nita*, thy, and *ta*, his, as *mita-oñspe*, my axe, *nita-çuñke*, thy dog. These pronouns are also used with *koda*, friend, and *kitçuna*, comrade. In Hidatsa *mata*, *dita* (for *nita*), and *ita*, are used in a similar manner. In the Tutelo the pronouns of this form occurred in a

few examples, but only with certain words of personal connection or relations, in which their use seems to resemble that of the Dakota pronouns with the words meaning "comrade" and "friend." Thus we heard *witāmañki*, my husband, *yitāmañki*, thy husband, *etāmañki*, her husband. So *witāmiheñ*, my wife (*i. e.* my woman), *yitāmiheñ*, thy wife; and *witagūtçkāi*, my son, *i. e.* "my boy," from *wagūtçkāi*, boy (evidently the same word as the Dakota *koçka*, young man). In the latter example *witagūtçkāi*, apparently expresses a lower bond or sense of relationship than *witêkai*,—not "my child," but "my boy," or "my youth," who may leave me and go elsewhere at any time.

In Tutelo the pronouns indicating property or "transferable possession" were commonly found in a separate and apparently compound form, following the noun, which was then sometimes (though not always) heard in the shortened or "construct" form. Thus with *hisēpi*, axe, we have:

hisēp' migītŏwi	(or *milītowi*) my axe	*hisēp' mahgītowi*	our axe
hisēp' yiñgītowi	thy axe	*hisēp' iñgītombūi*	your axe
hisēp' gītowi	his axe	*hisēp' gitohnēi*	their axe

So *sās*, bed, has *sās miñgītowi*, my bed, *sas yingītowi*, thy bed, *sas gītowi*, his bed.

With *tçoñgo*, dog, we find a different form:

tçoñgo wahkimpi	my dog	*tçongo maokimpi* (or *mahkimpi*)	our dog
tçoñgo yahkimpi	thy dog	*tçongo yahkimpūi*	your dog
tçoñgo cohkimpi	his dog	*tçoñgo kimpena*	their dog

The first of these forms, *migītowi*, &c., is evidently the same that appears in the Dakota *mitawa*, mine, *witawa*, thine, *tawa*, his, *uñkitawa*, ours. The Hidatsa has similar forms, *matamae*, *ditamae*, and *itamae*, often pronounced *matawae*, *nitawae*, and *itawae*. Dr. Matthews regards them as compounds formed by prefixing the pronouns *mata*, *dita* (*nita*) and *ita* to the noun *mae* (or *wae*) signifying personal property, which seems a very probable explanation.

The form *wahkimpi* may be similarly explained. In Dakota *kipá* signifies, to keep for me, and *kipi*, to hold or contain. The sense of property or possession is apparently implied, and *tçongo wahkimpi* in Tutelo probably means "the dog my property," or "the dog I have."

The possessive pronouns are used by themselves in Tutelo in the following affirmative and negative forms:

mimigītŏwi (or *mimigītowe*, or *milītowi*)	mine, or, it is mine
yiñgītowi (*yingītowe*, *yiñkītowi*)	thine, or, it is thine
iñgītowi (*iñgītowe*, *iñkītowi*)	his, or, it is his
maqgitowi (or *mahgītowe*, or *mahkitowi*)	ours, or, it is ours
yingitombūi (or *yiñkitombui*)	yours, or, it is yours
gitoñnēsel (or *kitoñnesel*)	theirs, or it is theirs

Negative Form.

kimigītonañ (kimikītonañ)	it is not mine
kiñyigītonañ	it is not thine
kigītonañ	it is not his
kinaggitonañ	it is not ours
kiñyigītombōnañ	it is not yours
kigītoqnēnañ	it is not theirs

The proper form of the first personal affirmative is doubtless *migītowi* (or *mikītowe*). In *mimigītowi* the first syllable is evidently from the separate pronoun *mīm*, I, used for emphasis. In the Dakota the forms *miye mitawa*, me, mine, *niye nitawa*, thee, thine, &c., are used for the same purpose.

The negative form is not found in either the Dakota or the Hidatsa, and may be regarded as another instance of the greater wealth of inflections possessed by the Tutelo.

The following are the interrogative demonstrative and indefinite pronouns in the Tutelo, so far as they were ascertained. The Dakota and Hidatsa are added for comparison :

Tutelo.	Dakota.	Hidatsa.	
ētowā, or *hetōa*	*tuwe*	*tape*	who?
ākeñ, kaka	*taku*	*tapa*	what?
ētuk	*tukte*	*to ; tua*	which?
tɔkēnùñ	*tona ; tonaka*	*tuami*	how many?
tewakītùnɯ̄	*tuwetawa*	*tapeitamae*	whose (is it)?
nēke, or *nēikiñ ; heiki*	*de*	*hidi ; kini*	this
yukān ; hēwa ; enā	*he ; ka*	*hido ; hino*	that
ohōn, or *ohō*	*ota*	*ahu*	many
hōk, hūk, ōkahōk	*owasiñ ; iyuqpa*	*etsa ; qakaheta*	all

The general resemblance of most of these forms is apparent. In the Tutelo for "whose?" which might have been written *tewagī'ùñwa*, we see the affix of the possessive pronoun (*gītowe*) inflectedto make an interrogative form. The Dakota and Hidatsa use the affix (*tawa* and *tamae*) without the inflection.

The Verb.

There are two very striking peculiarities in which the Dakota and Hidatsa dialects differ from most, if not all, Indian languages of other stocks. These are: firstly, the manner in which the personal pronoun is incorporated with the verb; and, secondly, the extreme paucity or almost total absence of inflections of mood and tense. In the first of these peculiarities the Tutelo resembles its western congeners ; in the second it differs from them in a marked degree—more widely even than the Latin verb differs from the English. These two characteristics require to be separately noted.

In most Indian languages the personal pronouns, both of the subject and of the object, are in some measure either united with the verb or in-

dicated by an inflection. The peculiarity which distinguishes the languages of the Dakotan stock is found in the variable position of these incorporated pronouns. They may be placed at the beginning, at the end, or between any two syllables of the verb. The position of the pronoun is not, however, arbitrary and dependent on the pleasure of the speaker. It appears to be fixed for each verb, according to certain rules. These rules, however, seem not yet to have been fully determined, and thus it happens that a Dakota dictionary must give the place of the pronoun in every verb, precisely as a Latin dictionary must give the perfect tense of every verb of the third conjugation. Thus, for example, in the Dakota proper, *kaçká*, to bind (or rather "he binds"), makes wa*káçka*, I bind, ya*kakça*, thou bindest; *manoñ*, he steals, makes *ma*wá*noñ*, I steal, *ma*yá*noñ*, thou stealest; and *etçíñ*, he thinks, makes *etçáñ*ni, I think, *etçáñ*ni, thou thinkest, the suffixed pronouns receiving a peculiar form. In the Hidatsa, *kidĕçi*, he loves, makes ma*kidĕçi*, I love, da*kidĕçi*, thou lovest; *eke*, he knows, becomes *e*ma*ke*, I know, and *e*da*ke*, thou knowest; and *kitsahike*, he makes good, becomes *kitsahike*ma, I make good, and *kitsahike*da, thou makest good. The Tutelo has the pronouns sometimes prefixed, and sometimes inserted; no instances have been found in which they are suffixed, but it is by no means improbable that such cases may occur, as verbs of this class are not common in either of the former languages, and our examples of conjugated verbs in Tutelo are not very numerous. Among them are the following:

1. Verbs with prefixed pronouns:

lakpése, he drinks
ya*lakpése*, thou drinkest
wa*lakpése*, I drink

hiantkapēwa, he sleeps
ya*hiantkapēwa*, thou sleepest
wa*hiantkapēwa*, I sleep

tēwa, he is dead
yi*tēwa*, thou art dead
wi*tēwa*, I am dead

2. The verbs in which the pronouns are inserted seem to be the most numerous class. The following are examples:

*ha*hēwa, he says
*ha*yihēwa, thou sayest
*ha*wahēwa, I say

*maha*náñka, he sits down
*maha*yináñka, thou sittest down
*maha*mináñka, I sit down

iñksēha, he laughs
*iñ*ya*ksēha*, thou laughest
*iñ*wa*ksēha*, I laugh

oháta, he sees
*o*ya*háta*, thou seest
*o*wa*há'a*, I see

The pronouns may be thus inserted in a noun, used with a verbal sense. Thus *wahtāka* or *wahtakai*, man or Indian, may be conjugated:

wahtākai, he is an Indian
wayihtākai, thou art an Indian
wamihtākai, I am an Indian

It is remarkable, however, that the pronoun of the first person plural is usually (though not always) prefixed. Thus from *mahanáñka*, he sits down, we have (as above) *mahaminañka*, I sit down, and mañk*mahanánka*, we sit down. So, ma*iñksēha* (or sometimes wa*iñksēha*), we laugh, and ma*ohata*, we see. On the other hand, we find *ha*mank*hewa*, we say, from *hahewa*, he says, making (as above) *ha*wa*hewa*, I say.

The word *manoñ*, he steals, has in Dakota the pronouns inserted, as is shown in the examples previously given. The similar word in Tutelo, *manōma* or *manūma*, has them prefixed, as yi*manōma*, thou stealest, ma*manōma*, I steal. But on one occasion this word was given in a different form, as *manundāñi*, he steals; and in this example the pronouns were inserted, the form of the first personal pronoun, and of the verb itself in that person, being at the same time varied, as *mayinundāñi*, thou stealest, *ma*mi*nundame*, I steal. In Dakota the place of the pronoun is similarly varied by a change in the form of the verb. Thus *baksá*, to cut off with a knife, makes *ba*wà*ksa*, I cut off (with the pronoun inserted), while *kaksá*, to cut off with an axe, makes wa*káksa*, I cut off (with the pronoun prefixed), and so in other like instances.

The other peculiarity of the Dakota and Hidatsa languages, which has been referred to, viz., the paucity, or rather absence, of all changes of mood and tense which can properly be called inflections, is in striking contrast with the abundance of these changes which mark the Tutelo verb. The difference is important, especially as indicating that the Tutelo is the older form of speech. It is an established law in the science of linguistics that, in any family of languages, those which are of the oldest formation, or, in other words, which approach nearest to the mother speech, are the most highly inflected. The derivative or more recent tongues are distinguished by the comparative fewness of the grammatical changes in the vocables. The difference in this respect between the Tutelo and the western branches of this stock is so great that they seem to belong to different categories or genera in the classification of languages. The Tutelo may properly be styled an inflected language, while the Dakota, the Hidatsa, and apparently all the other western dialects of the stock, must be classed among agglutinated languages, the variations of person, number, mood and tense being denoted by affixed or inserted particles,

Thus in the Hidatsa there is no difference, in the present tense, between the singular and the plural of a verb. *Kidĕçi* signifies both "he loves" and "they love;" *makidĕçi*, "I love," and "we love." In the future a distinction is made in the first and second persons. *Dakidĕcidi* signifies

"thou wilt love," of which *dakidĕcidiha* is the plural, "ye will love." In this language there is no mark of any kind, even by affixed particles, to distinguish the present tense from the past, nor even, in the third person, to distinguish the future from the other tenses. *Kidĕçi* signifies he loves, he loved, and he will love. The Dakota is a little better furnished in this way. The plural is distinguished from the singular by the addition of the particle *pi*, and in the first person by prefixing the pronoun *uñ*, they, in lieu of *wa* or *we*, I. Thus *kaçká*, he binds, becomes *kaçkápi*, they bind. *Wakaçka*, I bind, becomes uñ*kaçka*pi, we bind. No distinction is made between the present and the past tense. *Kaçká* is both he binds and he bound. The particle *kta*, which is not printed and apparently not pronounced as an affix, indicates the future. It sometimes produces a slight euphonic change in the final vowel of the verb. Thus *káçke kta*, he will bind, *kaçkápi kta*, they will bind. All other distinctions of number and tense are indicated in these two languages by adverbs, or by the general context of the sentence.

In lieu of these scant and imperfect modes of expression, the Tutelo gives us a surprising wealth of verbal forms. The distinction of singular and plural is clearly shown in all the persons, thus:

opēwa, he goes	*opehéhla*, they go
oyapēwa, thou goest	*oyapepūa*, ye go
owapēwa, I go	*maopēwa*, we go

Of tenses there are many forms. The termination in *ēwa* appears to be of an aorist, or rather of an indefinite sense. *Opēwa* (from *opa*, to go) may signify both he goes and he went. A distinctive present is indicated by the termination *ōma;* a distinctive past by *ōka;* and a future by *ta* or *ēta*. Thus from *ktē*, to kill, we have *waktēwa*, I kill him, or killed him, *waktcōma*; I am killing him, and *waktēta*, I will kill him. So *ohāta*, he sees it, becomes *ohatiōka*, he saw it formerly, and *ohatēta*, he will see it. *Opēwa*, he goes (or went), becomes *opēta*, he will go, inflected as follows:

opēta, he will go	*opehéhla*, they will go
oyapēta, thou wilt go	*oyapétepa*, ye will go
owapēta, I will go	*maopēta*, we will go

The inflections for person and number in the distinctively present tense, ending in *oma*, are shown in the following example:

waginōma, he is sick	*waginónhna*, they are sick
*wayiñ*ɔ*inoma*, thou art sick	*wayiñ*ɔ*inómpo*, ye are sick
*w*ɔ*mɛginōma*, I am sick	*mañ*ɔ*waginōma*, we are sick

Ohāta, he sees it, is thus varied:

ohata, he sees it	*ohatéhla*, they see it
oyahata, thou seest it	*oyahatbua*, ye see it
owahata, I see it	*maohata*, we see it

ohatiōka, he saw it	*ohatiokehla*, they saw it
oyahatiōka, thou sawest it	*oyahatiokewa*, ye saw it
owahatiōka, I saw it	*maohatioka*, we saw it
ohatēta, he will see it	*ohatetéhla*, they will see it
oyahatēta, thou wilt see it	*oyahātetbūa*, ye will see it
owahatēta, I shall see it	*maohātēta*, we shall see it

The following examples will show the variations of person in the aorist tense:

hahēwa, he says	*hahéhla*, they say
hayihēwa, thou sayest	*hayihēpua*, ye say
hawahēwa, I say	*hamañkhēwa*, we say
kĭhnindēwa, he is hungry	*kĭhnindēse*, they are hungry
yikĭhnindēwa, thou art hungry	*kĭhnindēpūa*, ye are hungry
mikĭhnindēwa, I hungry	*mahkihnindēwa*, we are hungry.

Wakoñspēwa, I remember it, an aorist form, becomes in the preterite *wakoñspeōka*, and, in the future, *wakoñspēta*. It is thus varied in the aorist and past tenses:

wakoñspēwa, I remember it	*makikoñspēwa*, we remember it
yakoñspēwa, thou rememberest it	*yakoñspeɣūa*, ye remember it
kikonspewa, he remembers it	*kikoñspēhēla*, they remember it
wakoñspeōka, I remembered it	*makikoñspeōka*, we remembered it
yakoñspeōka, thou rememberedst it	*yakoñspepuyoka*, ye remembered it
kikoñspēoka, he remembered it	*kikoñspeleōka*, they remembered it

In several instances verbs were heard only in the inflected forms. For the simple or root-form, which doubtless exists in the language, we are obliged to have recourse to the better known Dakota language. Thus *opewa*, he went, and *opeta*, he will go, indicate a root *opa*, he goes, which is actually found in the Dakota.

So *manōma* (which is probably a distinctively present tense), and *manondañi*, both meaning he steals, indicate a briefer root-form which we find in the Dakota *manoñ*, having the same meaning. *Manōma*, which is probably a contraction of *manoñōma*, is thus varied:

manōma, he steals	*manoñnese*, they steal
yimanōma, thou stealest	*yimanompūa*, ye steal
mamanōma, I steal	*mañkmanōma*, we steal

From these examples it is evident that there are variations of inflection, which, if the language were better understood, might probably be classified in distinct conjugations. Other instances of these variations will be given hereafter.

It is well known that in the Iroquois, Algonquin, Cherokee, and other Indian languages, of different stocks, there are many forms of the verb, nega-

tive, interrogative, desiderative, and the like, which are among the most notable characteristics of these languages, and add much to their power of expression. The Tutelo has several of these forms, but none of them are found in the Dakota or Hidatsa, both of which express the meaning of these forms by adverbial phrases or other circumlocutions. The negative form in Tutelo is made (in a manner which reminds us of the French *ne-pas*) by prefixing *k* or *ki* to the affirmative and suffixing *na*. The tense terminations *oma*, *owa*, and *ewa*, become *ona* and *ena* in this form:

inksēha, he laughs	*kinkséhna*, he does not laugh
iñwaksēha, I laugh	*kiñwahsehna*, I do not laugh
wameginōma, I am sick	*kiwameginōna*, I am not sick
waktēwa, I killed him	*kiwaktēna*, I did not kill him
owaklāka, I speak	*kowaklākna*, I do not speak
waktcōma, I am killing him	*kiwakteōna*, I am not killing him
yahōwa, he is coming	*kiahōna*, he is not coming

Kiñksehna, he is not laughing, is thus varied in the present tense:

kiñkséhna, he is not laughing'	*kiñksehanēna*, they are not laughing
kiñyakséhna, thou art not laughing	*kiñyakséhpuna*, ye are not laughing
kiñwakséhna, I am not laughing	*kimaeñkséhna*, we are not laughing

The interrogative form terminates in *o*, as:

yaktēwa, thou killedst him	*yaktēwo*, didst thou kill him?
yakteoma, thou art killing him	*yakteoñmo*, art thou kiling him?
yatēta, thou wilt kill him	*yaktē'o*, wilt thou kill him?
yatiwa, thou dwellest	*toka yatiwo*, where dost thou dwell?
alēwa, he is going	*toka alewo*, where is he going?

It is evident that this form is an inflection, pure and simple. It is a vowel change, and not in any manner an agglutinated particle. It takes the place of that elevation of tone with which we conclude an interrogative sentence, and which, strange to say, is not heard among the Dakotas. Mr. Riggs remarks that "unlike the English, the voice falls at the close of all interrogative sentences."

The desiderative form appears to be expressed by the affixed particle *bi* or *be*, but the examples which were obtained happened to be all in the negative, thus:

owapēwa, I go	*kowapēbina*, I do not wish to go
opetēse, he is going, or will go	*kopēbenīse*, he does not wish to go
hawīlewa, I come	*kiwīlēbīna*, I do not wish to come
waktewa, I kill him	*kiwaktēbina*, I do not wish to kill him

The imperative mood is distinguished apparently by a sharp accent on the final syllable of the verb, which loses the sign of tense. Thus from the *ñjō*, to give (in Dakota and Hidatsa, *ku*), which appears in *maingōwa*, I

give to you, we have, in the imperative, *masā mingó*, give me a knife. *kitēse* or *kitesel*, he kills him, gives *kité tçoñki*, or *tçoñk' kité*, kill the dog.

In the western languages of the Dakota stock, certain particles prefixed to the verb play an important part in modifying the meaning. Thus in Dakota and Hidatsa the prefix *pa* signifies that the action is done with the hand. From *ksa*, Dak., meaning separate, we have *paksá*, to break with the hand; from *qu*, Hid., to spill, *paqu*, to pour out with the hand. The Dakota *na*, Hidatsa *ada* (for *ana*) are prefixes showing that the action is done with the foot. The Dakota *ya*, Hidatsa *da* (often pronounced *ra* or *la*) show that the act is done with the mouth. *Ka* (Dak.) and *dāk* (Hid.) indicate an act done by a sudden, forcible impulse, &c. Attempts were made to ascertain whether similar prefixes were employed in the Tutelo speech. It was found that in many cases the latter had distinct words to express acts which in the western languages were indicated by these compound forms. Still, a sufficient number of examples were obtained to show that the use of modifying prefixes was not unknown to the language. Thus the root *kusa*, which evidently corresponds with the Dakota *ksa*, signifying separation, occurs in the following forms:

nantkūsisel, he breaks it off with the foot
latkūsisel, he bites it off
tikūsisel, he breaks it off by pushing
lakatkūsisel, he cuts it off with an axe

The Dakota *na*, signifying action with the foot, is evidently found, with some modification, in the Tutelo *nantkūsisel* above quoted, and also in *nañkōkisek*, to stamp with the foot, and in *konaqlōtisel*, to scratch with the foot. So the cutting, pushing, or impulsive prefix, *lak* or *laka*, which appears in *lakatkūsisel*, is found also in *lakatkūsisel*, he cuts open, *lakaspēta*, to cut off in pieces, *lakasāse*, to chop, *lakapleh*, to sweep the floor. *La*, which in *latkūsisel* indicates action with the mouth, is found also in *lakpēse*, to drink, and perhaps in *yilanāha*, to count or read, which has the corresponding prefix *ya* in the Dakota word *yāwa*, of like meaning

The affixed or incorporated pronouns are used with transitive verbs to form what are called by the Spanish writers on Indian grammar *transitions*, that is, to express the passage of the action from the agent or subject to the object. This usage is governed by very simple rules. In the Dakota and Hidatsa the rule prevails, that when two affixed pronouns come together, the one being in the nominative case and the other in the objective, the objective always precedes the nominative, as in *mayakoç'a* (Dak.) methou-bindest, *dimakidēci* (Hid.) thee-I-love. In the Dakota the third personal pronoun is in general not expressed; *kaç'á* signifies both he binds, and he binds him, her, or it; *wakáçka* is I bind, and I bind him, &c. In the Hidatsa, this pronoun is not expressed in the nominative, but in the objective it is indicated by the pronoun *i* prefixed to the verb, as *kidēçi*, he loves; *ikideçi*, he loves him, her or it.

The Tutelo, as far as could be ascertained, follows the usage of the Dakota

in regard to the third personal pronoun (which is not expressed) but differs from both the other languages, at least in some instances, in the order of the pronouns. The nominative affix occasionally precedes the objective, as in MAYI*newa*, I-thee-see. Yet in *kohinañ'*WIYA*hewa*, me-thou-struckest (where the pronouns are inserted), this order is reversed. The rule on which these variations depend was not ascertained. Owing to the difficulties of an inquiry carried on through the medium of a double translation (from English into Cayuga or Onondaga, and from the latter into Tutelo), it was not easy to gain a clear idea of the precise meaning of many of the examples which were obtained. An Indian when asked to translate "I love thee," or "thou lovest me," unless he is an educated man, or perfectly familiar with the language in which he is addressed, is apt to become perplexed, and to reverse the meaning of the pronouns. The following examples, however, will suffice to show that the system of transitions exists in the Tutelo, though they do not enable us to analyze and reconstruct it completely. Many other examples were obtained, but are omitted from a doubt of their correctness.

wakteōma, I am killing him
waikteōma (for *wayikteōma*) I am killing thee
mikteōma he is killing me
yakteōma, thou art killing him
kiteóñsel, he is killing them

inēwa, he sees him (or he saw him)
minēwa, I see him (qu. *m'inēwa*, for *ma-inēwa*)
mayinēwa, I see thee
miinēwa, he sees me
yiinēwa, he sees thee
miinēhla, they see me

yandostēka, he loves him
yandomistēka, he loves me
yandoyistēka, he loves thee
yandowastēka, I love him
yandoyastēka, thou lovest him
yandoyistēka, he loves thee
mankiandostēka (qu. *maikiandoyistēka*), we love thee
maihiandostekanēse, we love them
waiyandostēka, he loves us
waiyandoyastēka, thou loved us
yandostekanēse, he loves them (or they love him)
yandomistēkana, they love me

kohinañhiwa, he struck (or strikes) him
kohinañkyihiwa, he struck thee
kohinañmihiwa, he struck me

kohinañwahīwa, I struck him
kohinañyahīwa, thou struckest him
kohinañkwiyahīwa, thou struckest me
kohinañmañkihīwa, we struck him

gikōha (or *kikōha*), he calls to him
wigikōha, I call to him
waingikōha, (for *wayingikōha*), I call to thee
iñgikohīse (for *yingikohīse*), he calls to thee
iñgikopolēse, he calls to you
miñgikoha, he calls to me
yigikoha, thou callest to him
ingikopūa, they call to you
gikohanēse, they call to them

From the foregoing examples it is evident that the system of transitions in the Tutelo is as complete as in the Dakota and Hidatsa. But there are apparently some peculiar euphonic changes, and some of the pronouns are indicated by terminal inflections, particularly in the second person plural and in the third person singular and plural.

In the Tutelo, as in the Dakota and Hidatsa, substantives and adjectives are readily converted into neuter verbs by the addition or insertion of the pronouns and the verbal suffixes. It is in this manner that these languages, like other Indian tongues, are generally enabled to dispense with the use of the substantive verb. Thus in the Dakota *wiŋçaçta*, man, by inserting the pronoun *ma*, I, becomes *wimaŋçaçta* or *wiŋçamaçta*, I am a man, and by inserting *uñ* (we) and adding the plural affix *pi*, becomes *wiuñ'çaçtapi*, we are men. So also *waçte*, good, becomes *mawaçte*, I am good, *uñwaçtepi*, we are good.

In the Tutelo the word *wahtāka*, or *wahtākai*, man, is inflected as follows:

wamihtākai, I am a man.
wayihtākai, thou art a man.
wahtākai, he is a man.
niwamihtākai, we are men.
iñwahtākai, ye are men.
hūkwahtākai, they are men.

The last two forms appear not to be regular, and may have been given by mistake. *Hūkwahtākai* probably means "all are men."

This verb may take the aorist form, as:

wamihtakāwa, I am (or was) a man.
wayihtakāwa, thou art (or wast) a man.
wahtakāwa, he is (or was) a man, &c.

So the adjective *bĭ*, good, becomes, with the aorist affix *wa*, *bĭwa*, he is (or was) good; *yimbĭwa*, thou art good; *mimbĭwa*, I am good. In the

present tense we have *ebīse*, he is good; *ebilēse*, they are good; and in the preterit, *ebikōa*, he was good.

Adverbs.

In many cases, as has been already shown, the English adverb is indicated in the Tutelo by a modification of the verb. The negative adverb, for example, is usually expressed in this manner, as in *iñkseha*, he is laughing, *kiñksehna*, he is not laughing; *migītowe*, it is mine, *kimigītonañ*, it is not mine.

Sometimes the meaning which in English would be expressed by an adverb accompanying a verb, is expressed in Tutelo by two verbs. Thus we have *ihōha*, she is sewing, apparently from a root *ihō* or *yehō*, to sew; and *koñspēwa yehō*, she is sewing well, *i. e.*, she is careful in sewing (lit., she thinks, or remembers, in sewing); *kebīna yehō*, she is sewing badly, *i. e.* she does not well in sewing (or is not good at sewing). Here *kebīna* is the negative form of *biwa*, he (or she) is good.

Prepositions.

Many phrases were obtained with a view of ascertaining the prepositions of the Tutelo, but without success. Sometimes an expression which in English requires a preposition would in the Tutelo appear as a distinct word. Thus, while *ati* signifies a house, *tokai* was given as equivalent to "in the house." It may perhaps simply mean "at home." Prairie is *latāhkoi*, but *onīi* signifies "at the prairie."

Other examples would seem to show that the prepositions in the Tutelo, as in the Hidatsa, and to a large extent in the Dakota, are incorporated with the verb. Thus *tāhkai* signifies "woods," and *tāhkai aginēse*, he is in the woods. So *sūi*, hill, and *sūi aginēse*, he is on the hill. The phrase "I am going to the house" was rendered *wilēta iatā*, and the phrase "I am coming from the house," by *waklēta iatā*. The practice of combining the preposition with the verb is very common in the Indian languages, which merely carry to a greater extent a familiar usage of the Aryan speech. The expressions, to ascend or descend a hill, to circumnavigate a lake, to overhang a fence, to undermine a wall, are examples of an idiom so prevalent in the Indian tongues as to supersede not merely the cases of nouns, but to a large extent the separable prepositions.

Conjunctions.

In the Tutelo, conjunctions appear to be less frequently used than in English. An elliptical form of speech is employed, but with no loss of clearness. The phrase "when I came, he was asleep," is expressed briefly *wihiok, hiañka*, I came, he was asleep. So, "I called the dog, but he did not come," becomes *wagelākiok tçoñk, kihūna*, I called the dog, he came not. When it is considered necessary or proper, however, the conjunction is expressed, as *kuminēna, mi Jān hinēka*, I did not see him, but John saw him. Here "but" is expressed by *mi*.

Nigás signifies "and," or "also." *Waklumīha lubūs nigás masé̱ñ*, I bought a hat and a knife. *Owakiōka waktāka nigás mihé̱ñ nomba lek*, I met a man and two women.

Li, which expresses "if," appears to be combined with the verb, at least in pronunciation; thus: *Lilīok, wagelāgita*, If he comes, I will tell him; *wilūta, Jan lihiōk*, I will come if John comes. It is noticeable in the last two examples that the accent or stress of voice in the word *lihiok*, if he comes, appears to vary with the position of the word in the sentence.

Syntax.

The only points of interest which were ascertained in regard to the syntax of the language related to the position of words in a sentence.

The adjective follows the noun which it qualifies, as *wahtake bī*, good man, *atī asāñ*, white house. The rule applies to the numerals, as *mihāñ noñsa*, one woman, *atī noñbai*, two houses. In this respect the Tutelo conforms to the rule which prevails in the Dakota and Hidatsa languages, as well as in the dialects of the Iroquois stock. In the Algonkin languages, on the other hand, the adjective precedes the noun.

The position of the verb appears to be a matter of indifference. It sometimes precedes the noun expressing either the subject or the object, and sometimes follows it, the meaning being determined apparently, as in Latin, by the inflection. Thus "I see a man," is *minēwa waiwāq* (I see him a man); and "the man sees me" is *miinēwa waiwāq* (he sees me the man). *Tçoñko miñgō*, give me a dog; *kitē tçoñki*, kill the dog. In the last example the change from *tçoñko* to *tçoñki* is apparently not a grammatical inflection, but is merely euphonic. The verb in the imperative mood sufficiently shows the speaker's meaning, and the position of the noun is a matter of emphasis. "A *dog* give me," not a knife; "*kill* the dog," don't let him escape.

A verb is placed after another verb to which it bears the relation expressed by our infinitive; as *miñgiloqkō waktēta*, let me kill him (allow me, I will kill him). *Wakonta opēta*, I will make him go (I cause him he will go).

The euphonic changes which words undergo in construction with other words are as marked in this language as they are in the proper Dakota tongue, and seem to be often of a similar, if not identical, character in the two languages. Thus in Dakota the word *çuñka*, dog, becomes *çuñke* when a possessive pronoun is prefixed. In the Tutelo a similar change takes place when the position of the noun is altered; thus we have *tçoñko miñgō*, give me a dog; *kitē tçoñki*, kill the dog. The terminal vowel is frequently dropped, and the consonant preceding it undergoes a change; thus in Dakota *yuza*, to hold, becomes *yus* in the phrase *yus majin*, to stand holding. In Tutelo *nahāmbi* (properly *nahāñbi*) or *nahābi*, day, becomes *nahāmp* (or *nahāp*), in *nahāmp lāli* (or *nahāp lali*), three days. In such instances the two words which are thus in construction are pronounced as though they formed a single word.

VOCABULARY.

Particular care was taken to obtain, as correctly as possible, all the words comprised in the comparative vocabulary adopted by Gallatin for his Synopsis of the Indian languages. Many other words, expressive of the most common objects or actions, have been added. The alphabetical arrangement is adopted for convenience of reference, in lieu of the different order which Gallatin preferred for the purposes of his work. The Dakota and Hidatsa words are derived from the dictionaries of Mr. Riggs and Dr. Matthews, with the necessary changes of orthography which are required for the direct comparison of the three languages.

When several words are given in the Tutelo list, they are sometimes, as will be seen, mere variations of pronunciation or of grammatical form, and sometimes entirely distinct expressions. The Tutelo has no less than four words for "man," *wahtāka*, *waiyūwa* (or *waiwaq*) *yū'ikañ*, and *nōna*, which have doubtless different shades of meaning, though these were not ascertained. There are also two distinct words meaning "to see," *inēwa*, and *ohāta*, and two for "go," *opēwa* and *qala* (or, rather *opa* and *la*, answering to *opa* and *ya* in Dakota). A more complete knowledge of the language would doubtless afford the means of discriminating between these apparently synonymous terms.

The words marked N in the vocabulary are those which were received from Nikonha himself. The pronunciation of these words may be accepted as that of a Tutelo of the full blood, and as affording a test of the correctness of the others.

	Tutelo.	Dakota.	Hidatsa.
Alive	inī, enī, inīna	ni	hiwakatsa
All	hūk, hōk, okahōk	iyuqpa	qukaheta; etsa
And	nigás	kha; tça; uñkañ; nakuñ	iça
Arm	hiçto (N) histo	isto	ara
Arrow	mañksīi; māñkōi (N)	wañhiñkpe	ita, maita
Ashes	alapōk	tçaqota	midūtsapi
Aunt	watemai; tomīn	tuñwin	içami; ika
Autumn	tāñyi, tā'i	ptañyetu	mata
Awake	kiklēse	kikta	itsi; hidamitats
Axe	nisēp (N), hisēpi, hisép	oñspe	maiptsa
Bad	okāyek (N) okāyik, ukāyik	çitça	icia
Bag	mañksūi	ojuha	içi
Ball	tapi	tapa	máotàpi
Berk (n)	qāpi; yohiñk	çañha	midaiçi; qùpi (v)
Bear	mūnti (N) mōnti, moñdi	mato	daqpitsi
Beads	watai	totodañ	akutohi

	Tutelo.	Dakota.	Hidatsa.
Beaver	yāop (N) munaqka	tçıpa	mirapa
Beard	yēhī ; istihiōi	putiñhiñ (hiñ, hair, içti, underlip)	iki (hi, hair)
Bed	sāsi	owinja	aduqùpi
Beg	oyándise	da ; kida	kadi
Bird	māyīñk	zitká ; wakiñyañ	tsakaka
Bird's nest	mayeñgiéqta,	hoqpi	ikiçi
Bite off (to)	latkūsisel,	yaksá	adudatsa
Black	asépi, asùp (N)	sàpa	cipi
Blood	wāyī (N)	we	idi
Blue	asōti	to ; sota	tohi
Body	tēsi ; yūqtéki	tañçañ ; (tezi, belly)	iqo (titsi, thick, stout)
Boil (to)	hīchā	ohañ ; ipiqya	midue
Bone	wahōi, wahūi	hu	hidu
Book	minagi	wowapi	
Boy	wakasīk (N); gutskai ; waitiwa	hokçidañ ; koçká	makadistamatse
Bow (n)	inōsīk, inōsek (N)	itazipa ; tinazipe	itanuqa ; minuqa
Brain	wasōti, wasūt	nasu	tsuùta
Bread	wagesākwāi, wāksākpāi	aguyapi	madahapi
Break (to) with foot	lakatkūsisel	naksá	anaqoqi
Brother	niwāgenúmpai (N) iñginumbai	tciñye	iaka; itanu; itametsa
Brother, elder (my)	witañsk ; wital ; wahīik	tciñye ; timdo	itametsa ; iaka
Brother, younger (my)	wisuñtk, minōn	misuñka	matsuka
Buffalo	iap; mampañdahkai	tatañka ; pte	kedapi ; mite
Burn (v. a.)	inausíngā	ghu ; aghu	anaqa
Bury	sùntése	ga ; huaka	
But	mi	tuka	
Buy	kilomīha ; wāglumihínta	opetoñ	maihu
Call (v. a.)	kikōha ; gelāki	kitço	kikuha (invite)
Canoe	miñkolhāpi, meñkolahāpi	wata ; cañwata	midaluetsa; minaluetsa
Cat	pūs (N) (i. e. puss)	inmuçuñka (dog-panther)	
Cause (v)	konta	etçonkiya	

	Tutelo.	Dakota.	Hidatsa.
Cheek	ùkstéh	tapoñ, iyoqa	
Cherry	yosañkrota	tcañpa, kakañpidan	matsu
Child	wakasĭk; wăgots-kăi (see *small*)	hokçiyopa	daka; makadiçta
Chop (*v*)	lakasăse	kaksa	naktsùki
Churn (*v*)	mampamasawohōka	botço	
Claw	oluskēse	tsake	tsakaka itsi
Cloud	maqōsi (N)	maqpiya	
Club	yehēti	tçañ otoza	midakaza titsi
Cold	sanī	sni	tsinīe
Come	yahūa, howa, hī	uwa	hu
Copper	penihēi	maza	netsahiçiçi
Count (*v*)	yĭlanāha	yawa	
Cranberry	hohnūñk	potkañka, potpañka	
Crane	kainstākai	pehañ	opitsa
Crow (*n*)	kāhi	untçʻçitçadañ	pedetska
Cry (*v*)	qāqise	tçeya	imia
Cut (*v*) *with knife*	lakatkōsa	baksá	naktsùki
Dance (*v*)	wagitçi (N), ketçi	watçi	kidiçi
Darkness	usĭhaa, ohsĭha	okpaza (hañ, *night*)	oktsi; tatsi
Daughter (*my*)	witēka (N), wi-ohañke, miohañk	mitcuñkçi	maka
Day	nahambe, nahamp, nahañpe	añpetu, añpé	mape
Dead	tē, tēka	ta	te
Deer	witāi	taqiñtça	tçitatùki
Devil (*evil spirit*)	mămpă isī	wakañçitça	
Die	tē (N), tēolāha	ta	te
Dog	tçoñg (N) tçoñgo tçoñki, tçoñk	çunka	maçuka
Drink (*v*)	lākpē, lapēta	yatkañ	hi; minhi
Duck	īçtai (N), heistañ, manēasēi (see *Goose*)	maghaksitça; skiska	miqaka
Ear	naqōq (N), nahūh	noghe; nakpa	akuqi
Earth	amāni, amāi	maka	ama
Eat	lūti	yuta	duti (nuti)
Egg	mayiñk pōs (see *Bird*)	witka	tsakakadaki
Eight	pālán (N) palāni, palāli	çadoghan	nopapi

	Tutelo.	Dakota.	Hidatsa.
Eighteen	agepalāli, akipalāni	ake çadoghañ	aqpidopapi
Eleven	agenosai, akinosai	ake wanjidañ	aqpiduetsa
Evening	osihitewa (see *Darkness, Night*)	qayetu	oktsiade
Eye	tasūi, tasūye (N) (mentasūi, my e.)	içta	içta
Face	talūkna ; tarūbna (mentalōken, my f.)	ite ; itohnake	ite
Father	eāti; tāt (N); yāt (N)	ate	ate ; tatiç
Fifteen	agegīsai, akekisāi	ake-zaptañ)	aqpikiqu
Finger	hāk (see *Hand*)	nape	çakiadutsamihe
Finger-nails	tsutsāki, tçutçāg	çake	çakiiçpu
Fire	pītç (N) pēti, pētç	peta	
Fish	wihoi (N)	hoghañ	mua
Five	kasā (N) kisē, kisañ, kisāhi, kisāháñi	zaptañ	kiqu
Flesh	wāyuqtéki, wayūqtik	tçeqpi ; tçonitça	idukçiti
Fog	manotihūa	opo	pue
Food	walūti	woyute	maduti
Foot	içi (N) isī	siha	itsi
Forehead	tikōi ; pania minte	ite	iqi
Forest	tāhkāi	tçoñtañka	
Four	tōp (N), tōpa, topai, toba	topa	topa
Fourteen	agetoba, akitopa	ake-topa	aqpitopa
Fox	tohkai	çuñgidañ	iqoka
Friend	witāhe, witaqā	koda ; kitçuwa	idakoe ; iko'pa
Ghost	wanùntçī	wanaghi	nokidaqi
Girl	wāgatç(N) wakasīk; kōmqāñ (N)	witçiñyañna	makadiçtamia ; miakaza
Go	opewa ; qala ; la	ya ; opa	nakon ; ne ; kaua
God	ēiñgyeñ, eīñgă	wakañtañku	daqi, naqi (spirit)
Good	ebī (N), bi, pī, ipī, bīwa	waçte ; pi (obsolete)	tsūki
Goose	manēasān	magha	mina
Grandfather	ekuñi, higūñ	tuñkañçidañ	adutaka
Grandmother	higūñ	kuñsitku ; uñtçi	iku
Grass	sùnktāki (N), muktāgi ; otōi	peji	mika'
Great	itáñi (N), itāñ	tañka	iqtia
Green	otō (N), otolakōi	to	tohiça

	Tutelo.	Dakota.	Hidatsa.
Gun	mīnktĕ (N)	mazakañ	
Hail	nōq	wasu	ma'kùqpitami
Hair	natónwe(N), nañtói, natói	natú; hiñ	ana; hi
Hand	hāg (N), hāki, āk	nape (çake, claw, finger-nail)	çaki
Handsome	pirē (N), ipī, ipīkam (see *good*)	owañyag waste	
Have	tahoñtanēki	tiñ-maçtiñtça	itūki
Hat	lubūs; kotubós (N)	wapaha	apoka
Hatchet	(see *axe*)		
He	im, i	iç, iye	i, çe
Head	pasūye (N), pasūi	pa	atu
Heart	yāñti (N), yanti; tāpī	tcante (tapi, liver)	na'ta (apiça, liver)
Here	nei	den, detu	
Him	e, ei, i	iye, iç	i
Himself	esái, isáñi	iye, iç	iqki
House	atī (N)	tipi	ati
How many	tokēnuñ	tona, tonaka	tuami, tuaka
Hundred	ukenī, okeni	opawiñghe	pitikiqtia
Hunger (v)	kihnindewa	wotektehda (hungry)	aniiti (hungry)
Husband	māñki	hihna	kida, kina
I	ma, mi, mīm	miç, miye	ma, mi
I alone or I myself	misáñi, misāi	mīye, miç, miçnana	miqki, mitsaki
Ice	noñhi; mīñgiratçah	tçagha	manūqi
If	li	kiñhañ	
Indian	wahtākai (*man*)	iktçewitçasta	amakanoqpaka
Iron	mañs, mās, masīqorāk	mazasapa	uetsa
Island	histēk, stēk, stestēki	wita	
Kettle	yesiñk	tçegha	miduqa
Kill	kitē (N), ktĕ, kitēse	kte, kata	ta, kitahe
Knife	masćñi, masēi, masāi (N) masă	isan	maetsi
Lake	(see *Sea*)		
Land	(see *Earth*)		
Laugh	inksēha, īñkçē (N)	iqa	ka'
Leaf	otōl, otōq (N)	ape; wapa	midapa

	Tutelo.	Dakota.	Hidatsa.
Leg	yeksā (N), ieksā, yeksāi; minī (*my leg*)	idiki or iniki	
Long	yapóske (N) sui; yumpañkatska	hañska	hatski; (tsua, *narrow*)
Love	yandowasteka	waçtedaka	kidĕçi
Maize	mandaqēi, mātāqē (N)	wamnaheza	kohati
Make	aōma, aōñ	uñ	he, hini
Man	wahtahka, wāiyuā (N), waiyūwa, waiwaq; yuhkañ, nōna	witçaçta	matse, itaka, çikaka
Marry	ohōn, ohōteha	ota	ahu
Me	mi, wi	ma, mi	mi
Meet	oaki	akipa	uzia
Mine	migītowe	mitawa	matawae
Moon	mīnōsā' (N), mimahēi (see *Sun*)	hañyetu-wi	makumidi
Morning	kanahāmpuai, kanahābnen (see *Day*)	hañhañna	ata
Mother	īnā (N), henā, henùñ	ina	hidu
Mountain	çūqe, sūhi; ohēki	qe; paha	amaqami
Mouth	ihī, īh (N)	i	i
Myself	(see "*I alone*")		
Near	iñktēi, āskai	kiyedañ	atsa
Neck	tasēi, mintasēi (my n.)	tahu ; dote	ampa
Night	usī, osī	hañ ; hañyetu	oktsi
Nine	tsāen or tça (N), sā, sāñ, ksānk ; ksākai, kasāñkai	naptçinwañka	nuetsapi
Nineteen	agekisañka	uñma-naptçinwañka	agpi-nuetsapi
No	yahan, ihao	hiya	desa ; nesa
None	pāqtē, paqti	poghe	apa
Oak	tāskahōi, taskahūi (N)		midakamiqka
Old	hōakāi, hōhka	kañ	qe, qie
One	noñç (N), noñs, nosāi, noñsa	wañji, sañni	nuetsa

	Tutelo.	Dakota.	Hidatsa.
Ours	maqgĭtowe	uñkitawa	matawae
Ourselves	maesāi, maesáñi		midohi
Partridge	wustetkai	zitça	
Pigeon	mayūtkāi, wayōtkāi	wakiyedañ	
Pine-tree	wāstī, wāste (N)	wazi	matsi
Pipe	yehíñstik (N), ihīrtik, iheñstek (qu, "*mouth-stone*")	tçotañka; tçañduhupa	ikipi
Pound (v)	pahē	apa	pa
Prairie	latahkoi	tiñta	amaadatsa, teduti
Rain	qawōi (N), qawōqa, hāwōhā, qawō	maghaju	qade
Raspberry	hasislāi	takañhetça	
Red	atsūti, atçūti, atçūt	duta (*scarlet*), ça (*red*)	hiçi
Remember	koñspēwa	kiksuya	
River	taksīta, taksītai	wakpa; watpa	azi
Run (v)	hinda, hantá (N)	inyañka	tinie
Say (v)	hahēwa (see *Speak*)	eya	idé
Sea	yetañi, yetāi, iētañ	mde (*lake*); miniwañtça (*one water*)	miníiqtia (*great water*)
See (v)	ohāta, inēwa, waqēta	toñwañ; wañyaka; wañhdaka	ika; atsiça
Seven	săgóm (N), sagomēi, sagomíñk	çakowiñ	çapua
Seventeen	agesagŏmi	ake-çakowiñ	aqpiçapua
Sew (v)	ihōha	kagheghe; ipasisa	kikaki
Shoes	handisonōi (N), añgohlēi, ā g ō r e, āgōdē	tcañhañpa	hupa; itapa
Shoot off (v)	opatañsel	bopōta	
Sick	waginōma	yazañ	iqoade
Sing (v)	yămùñiyē (N)	dowañ; ahiyaya	
Sister	minēk (N), tahañk	tawinoqtin; tañka, tanku	inu, itaku, içami
Sit	mahanañka	iyotañka	amaki
Six	agùs (N), akásp, akāspei	çakpe	akama
Sixteen	agegaspe	akeçakpe	aqpiakama
Sky	mañtōi, m a t o ñ i, matōi	maqpiya to	apaqi

	Tutelo.	Dakota.	Hidatsa.
Sleep (*v*)	hīyăñ (N); hianta, hiantkapewa	içtiñma	hami, hinami
Small	kutçkai (N), kūtskai, kotskai	tçistiñna; tçikadañ; niçkodañ	kariçta
Snake	wăgenī	wañ; wamduçka	mapokça
Son	witēka (N), tēkai; qūtçkai (see *Small*)	tçinktçi (koçká, *young man*)	idiçi
Speak	niça (N), sahéñta, sahīta, hahēwa, oaklaka	ia; yaotañiñ	idé, iné
Spring (*n*)	wehahempēi, wehaéhimpē; maste	wetu (maçté, *warm*)	
Squirrel	nistāqkai	taçnahetça; hetkadañ; ziça	
Stamp (*v*) *with foot*	nañkōkisek	natata, natañtañ	
Star	tabunītçkai (N), tapniñskai	witçañqpi	içka
Stay (*v*)	naña (see *Sit*)	yañka	daka
Steal	manoñ, manōma	manoñ	açadi
Stone	histéki, nistēk (N)	iñyañ	mi'
Strawberry	haspahínuk	wajuçtetça	amuáqoka
Strike	kohinùnhiwa	apa, kaçtaka	
Strong	itāi; soti; wāyupāki	suta; waç'aka	itsii
Summer	wēhē piwa (see *Spring*)	mdoketu	ade, mande
Sun	mīe or mīn (N), mi (see *Moon*)	wi	midi
Sweep (*v*)	lakaplék	kahiñta	
Ten	pōtsk (N), putsk, butçk, putskai, putskáñi	wiktçemna	pitika
That	yukān; nēikiñ	ka, koñ	ku
Thee	hi, yi	ni	ni
Their	gitonnēsel	tawapi	itamae
There	kowai	hetçi; heñ; ka; kañki	hidikoa; kuadi; çekoa
They	imahese	iyepi	i
Thine	yiñgītowe	nitawa	nitawae
Thirteen	agelali	ake-yamni	aqpinami
Thirty	putçka nani	wiktçemna yamni	damia-pitika

	Tutelo.	Dakota.	Hidatsa.
This	néke, nēikiñ	de ; detçedañ	hidi ; hini
Think	opemīha ; koñspēwa	eçiñ ; epça	idie ; inie
Thou	yīm, ya, ye	niç, ya, ye	na, ni
Thousand	okeni butskai, ukenī mbutskai	kektopawiñghe	pitikiqtia akakodi
Three	nān (N) nāni, lāt, lāni	yamni	nami, nawi
Thunder	tūi ; tūhangrūa	otiñ	tahu
Thyself	yisái, yesáñi	niye, niç	niqki
Tie (*v*)	olohī	iyakaçka ; paqta	dutskiti
Tobacco	yéhni, yihnū	tçañdi	ope
To-day	nahámblekéñ (see *Day*)	etçin ; nakaha ; añ-petu kiñ de	hini-mape
Toes	atkasusai	siyukaja ; sipiñkpa	itsiadutsamihe
To-morrow	nahampk (see *To-day*)	heyaketciñkañ	ataduk, ataruk
Tongue	netçi, netsi, letci	tçeji	dezi (nezi)
Tooth	ihī (N)	hi	i, hi
Town	māmpī, māmbī	otoñwe	ati, ati ahu
Tree	onī ; wiéñ (N) mīéñ (see *Wood*)	tçañ	mina (wood)
Turkey	māndāhkāi, māndùhkāi	zitça tañka	
Twelve	agenomba	ake-noñpa	aqpidopa (agpi-nopa)
Twenty	putska nomba	wiktcemna noñpa	nopapitika
Two	nomp (N) nomba	noñpa	nopa, dopa
Ugly	ukāyik (see *Bad*)	owañyaq sitça	icia
Uncle (*my*)	minēk'	midekçi ; ate (*father*)	ate ; itadu
Us	mae, wae	uñ	mido, wiro
Valley	oñqyāyùñ	kaksiza ; tçokañ	amaqaktupi
Walk (*v*)	yalēwa (see *Go*)	mani	dide
Warm	akāteka, akātia	kata ; tçoza ; maçte	ade
Warrior	ērutāoñe	akitçita ; mdeta-huñka	akimakikua
Water	manī (N)	mini	mini, midi
We	mīm, mae, wae, mañ, māesáñ	uñ	
Weave	añktāka	yañka ; kazoñta	
Weep	qaka	tçeya	imia
Which	ētuk	tukte	tapa
What is that?	kakāñwā	taku (*what*)	tapa

	Tutelo.	Dakota.	Hidatsa.
When	tokēnāq	tohiñni ; kehañ	tuakaduk ; tuakaçedu
Where	tokā	toki, tokiya	torn, toka
White	asùñi (N), asañi, asai, asei	sañ ; ska	atùki ; oqati
Who	ketoa, hetōa	tuwe	tape
Whose	tewakĭ.ùnwa	tuwetawa	tapeitamae
Wife	(same as *Woman*) mihañi	tawitçu	itadamia ; ua
Wind	maniñkiē (N), mamùnklēi, maminkrē, omaklēwa	tate	hutsi
Winter	wāneñi, wānēi	wani, waniyetu	mana; tsinie (*cold*)
Wolf	mùñktagín (N), mùnktōkāi, maktukai	çuñktoketça	motsa ; tçeça
Woman	miháñi, mihañ (N), mahēi	winohintçā, wiñyañ	mia
Wood	miyeñi, miéñ, miyēi	tçañ	mina
Work (*v*)	oknahō	qtani	dahe ; kikça
Ye	yim (see *Thou*)	niyepi	dido ; niro
Yellow	sīi	zi	tsi
Yes	ahá, aháñ, awāqa	hañ ; ho	e
Yesterday	sitō	qtanihañ	hudiçedu; huriçeru
Young	yéñki	askatudañ wota	
Your (*pl*)	yiñgītambūi	nitawapi	

Stated Meeting, April 20, 1883.

Present, 12 members.

President, Mr. FRALEY, in the Chair.

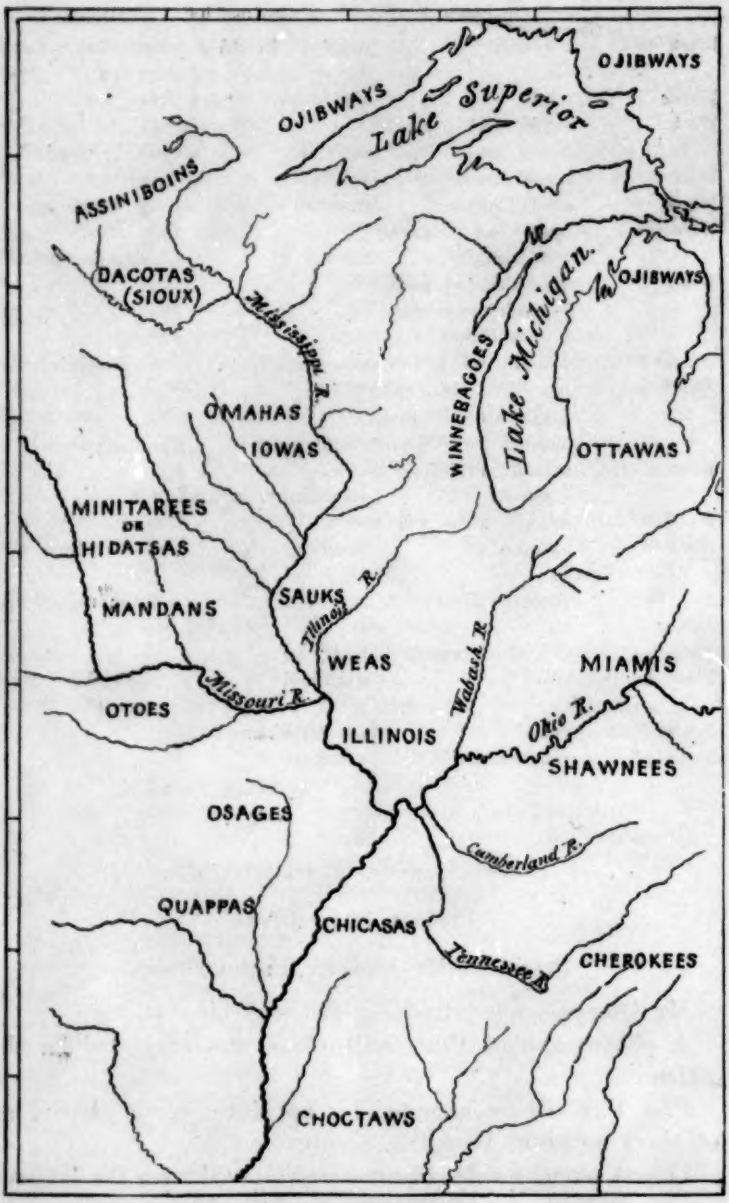
Mr. Claypole was introduced and took his seat.

A photograph of Prof. G. H. Cook was presented for the Album.

Prof. P. E. Chase accepted his appointment to prepare an obituary notice of Daniel B. Smith.

Letters of acknowledgment were received from the Holland

[*Continued on page 48.*]


OJIBWAYS
OJIBWAYS
Lake Superior
ASSINIBOINS
DACOTAS (SIOUX)
Mississippi R.
OJIBWAYS
Lake Michigan
WINNEBAGOES
OMAHAS
IOWAS
OTTAWAS
MINITAREES OR HIDATSAS
MANDANS
SAUKS
Illinois R.
Wabash R.
WEAS
MIAMIS
Missouri R.
OTOES
ILLINOIS
Ohio R.
SHAWNEES
OSAGES
Cumberland R.
QUAPPAS
CHICASAS
Tennessee R.
CHEROKEES
CHOCTAWS

OJIBWAYS
HURONS
St. Lawrence River
Quebec.
ABENAKEES
Ottawa R.
Montreal.
Lake Huron.
Georgian bay
ALGONKINS
HURONS
L. Ontario
Oswego
ONEIDAS
(CANIENGAS)
MOHAWKS
Brantford
1780
SENECAS
CAYUGAS
ONONDAGAS
1760
MASSACHUSETTS
Lake Erie
ERIES
Allegheny R.
CONESTOGAS
(SANDASTES)
Mountains.
MOHICANS
1745
New York.
DELAWARES
Philadelphia
Ohio R.
Susquehanna R.
Washington
Kenaahla R.
Big Sandy R.
Cumberland, or Alleghenies or Blue Ridge
Potomac R.
James R.
1671
1722
Roanoke R.
Black Mounts.
TUTELOS
1701.
Yadkin R.
Neuse R.
Cape Fear R.
CHEROKEES
CATAWBAS
Great Pedee R.
Santee R.
Savannah R.
CREEKS
Charleston.
A Sketch Map
showing the stations & direction
of the
Tutelo Migrations
between
A.D. 1671 and 1780.
Horatio Hale.
Proc. Amer. Phil. Soc. 1883.

Society (110, 111); the Fondation Teyler (111); and the Statistical Society of London (110, 111).

Letters of envoy were received from the Trigonometrical Survey of India, March 13th; the Central Observatory and the Botanic Garden at St. Petersburgh; the Musée Guimét; and the Meteorological Observatory at Cordoba, S. A.

Donations for the Library were received from the Royal Academy at Rome; the Société de Géographie; the Revista Euskara; London Nature; the Canadian Naturalist; Boston Natural History Society; Mr. J. R. Stanwood, Boston; Mr. S. A. Green, Groton; the Pennsylvania Historical Society; Pharmaceutical Association; Mr. Henry Phillips, Jr.; Mr. Albert S. Gatschet; Prof. H. Carvill Lewis; the U. S. Museum; U. S. Fish Commission; Mr. A. G. Bell; the American Antiquarian; University of Michigan; and Argentine Observatory.

The death of Jos. J. Lewis, of Westchester, April 6, aged 81, was announced by Mr. Fraley.

Prof. H. S. Williams of Cornell University, communicated a paper "On a Crinoid with movable spines," through Prof. Claypole, who explained the subject.

Prof. Claypole described a downthrow fault of 3500 feet, South of New Bloomfield, Perry county, Pa., and showed how the errors in the colored geological map of that county should be corrected.

Pending nominations, Nos. 979, 981 to 985 were read, and Nos. 979, 981 to 983 were balloted for.

Proceedings of the Society from 1744 to 1837, as condensed by the Librarian, were ordered to be printed, on the recommendation of the Committee of Five, the report of which was presented by Mr. Phillips, with estimates of cost, &c. On motion of Mr. Phillips the Secretaries were authorized to publish in *fac simile* the letter of Franklin, 1774, with which the records commence.

Mr. Fraley reported that he had received and paid over to the Treasurer $132.43, being the interest on the Michaux French rentes, due April 1.

On examination of the ballot boxes by the presiding officer,

the following persons were declared to be duly elected members of the Society:—

Prof. Angelo Heilprin, of Philadelphia.
Mr. Ambrose E. Lehman, of Philadelphia.
Mr. Dillwyn Parrish, of Philadelphia.
Mr. Phillip C. Garrett, of Germantown, Philadelphia.
Mr. Elisha Kent Kane, C. E., of Philadelphia.

And the meeting was adjourned.

Mediæval Sermon-Books and Stories. By Professor T. F. Crane, of Ithaca, New York.

(*Read before the American Philosophical Society, March 16, 1883.*)

It is the object of this article to direct attention to an important source of mediæval history which has long remained neglected. We allude to the great collections of stories made chiefly for the use of preachers, which, besides giving a picture of the culture of the later middle ages, such as can nowhere else be found, throw a flood of light upon the diffusion of popular tales.* Before considering these specific works, we shall examine briefly several other collections, also having a moral scope, but intended for the edification of the general reader. From the present article are excluded the Western translations of Oriental story-books, even where they approach the specifically Christian collections as closely as does the *Disciplina Clericalis* of Petrus Alfonsi.†

Until the beginning of the twelfth century, the literature of the class to which the adjective entertaining may be applied, was almost exclusively Christian and legendary. There still survived, it is true, historical and mythological reminiscences of the classical period, but these secular elements

* Thomas Wright, Latin Stories (Percy Society, Vol. viii), pp. vii-viii, first, to our knowledge, called attention to this subject. See also K. Goedeke, *Every Man, Homulus und Hekastus*, Hanover, 1864, p. viii; and *Orient und Occident, Eine Vierteljahrsschrift, herausgegeben von* T. Benfey, i, p. 531 (*Asinus vulgi*).

† The literature of the subject will be mentioned *passim*, but a few recent works of general interest may be noticed now, and hereafter they will be cited by the authors' names alone. A. Lecoy de la Marche, *La Chaire française du moyen âge, spécialement au treizième siècle, d'après les manuscrits contemporains, Ouvrage couronné par l'Académie des Inscriptions et Belles Lettres.* Paris, 1868; L. Bourgain, *La Chaire française au XII^e siècle, d'après les manuscrits*, Paris, 1879; R. Cruel, *Geschichte der deutschen Predigt im Mittelalter*, Detmold, 1879. A good survey of the French field will be found in C. Aubertin, *Histoire de la Langue et de la Littérature française au moyen âge*, Paris, 1876-1878, Vol. ii, pp. 296-386, and a review of Lecoy de la Marche's work may be found in the *Revue des deux Mondes*, 15. Aug., 1869, *Les Sermons du Moyen Age*, by Aubry-Vitet.

were swallowed up in the vast legendary cycles of the Church.* This slender stream, was, however, about the time of the Crusades, swollen by a torrent of Oriental fables and stories, which maintained their supremacy in the learned world until the Revival of Letters, and then became the cherished patrimony of the illiterate classes, and still delight the people of all Europe.† The influence of this Oriental element upon the literature of the West was profound, affecting its form, and contributing a mass of entertaining tales which owe their diffusion and popularity largely to their absorption into the various later Occidental story-books. The literature of which we are speaking would have remained unknown to the people, had they been compelled to make its acquaintance by reading. Fortunately, there existed an ecclesiastical channel by which some scanty rills of a literature not exclusively ecclesiastical trickled among the people, and this channel, curiously enough, was the pulpit. The origin, mode, and matter of this oral diffusion will constitute the subject of the present article, after the ground has been cleared by a rapid survey of three characteristic works which form a group by themselves.

The method of instruction by figures, parables, apologues and the like, is too old to be referred to Christian symbolization of classic mythological elements.‡ This undoubtedly gave a specific development to the existing tendency, and resulted in the mediæval *bestiaires* and *lapidaires*. The employment of fables for serious didactic purposes is also Oriental, and all students of later mediæval literature know the vast influence of the Pantschatantra in its various versions. The earliest one which could have any influence on the Orient was the Latin translation by Johannes de Capua, *Directorium humanæ vitæ*, made between 1263–78, and based on the Hebrew version of Rabbi Joel (1250). The so-called Esopian fables were preserved in the paraphrase of Romulus, the existence of which as early as the tenth century has been clearly proved by Oesterley.§ It is all the stranger, then, that the earliest distinctively mediæval collection of fables shows no traces of a specific Oriental or classic influence—we refer to the *Speculum Sapien-*

* For the popularity of Valerius Maximus, to which we shall later recur, see Kempf's edition, Berlin, 1854, pp. 47 *et seq.*, and for mythological reminiscences in the poems of the Troubadours, see Diez, *Die Poesie der Troubadours*, Zwickau, 1826, pp. 127, 140, and Birch-Hirschfeld, *Ueber die den provenzalischen Troubadours des XII. und XIII. Jahrhunderts bekannten Epischen Stoffe*, Halle, 1878, *ad init.*

† It is not true that Oriental fiction was *introduced* into Europe by the Crusades; not only had the transmission been going on at a much earlier date (see Benfey's *Pantschatantra*, Leipzig, 1859, Vol. 1, p. xxii), but the earliest Oriental collection, the *Disciplina Clericalis* of Petrus Alfonsi, was probably written before the first Crusade, quite certainly before 1106, the date of the Jewish author's conversion to Christianity.

‡ See Bartoli, *Storia della letteratura italiana*, Florence, 1878, Vol. 1, p. 83, who attributes the above origin to the mediæval moralizations. We are more inclined to trace it to the influence of the Orient.

§ *Romulus: Die Paraphrasen des Phædrus und die Æsopische Fabel im Mittelalter, von* H. Oesterley, Berlin, 1870.

tiae attributed to a certain Bishop Cyril.* Who Bishop Cyril was is not known, and Græsse is compelled to refer the work to a certain *Cyrillus de Quidenon poëta laureatus*, a Neapolitan from Quidone, a small town in the province of Capitanata, in the kingdom of Naples, who flourished in the XIII century. He was a learned theologian, as Græsse remarks, who has taken the trouble to note the numerous passages cited from the Bible, and he was also an acute scholastic philosopher. He was not acquainted with Æsop, and from a remark he makes in Book I, cap. 18. it is evident he knew no Greek. His work is of little importance for the history of mediæval fiction, for it exerted not the slightest influence.† It is, however, interesting in itself, and was translated into German, Spanish, and Bohemian. The author, in the prologue, makes an elaborate apology for the form of his work. This is so characteristic of this class of writings that we quote a few lines which may also give some idea of the author's extraordinary style. He says: "Secundum Aristotelis sententiam in Problematibus suis quamquam in exemplis in discendo gaudeant omnes, in disciplinis moralibus hoc tamen amplius placet, quoniam structura morum ceu ymagine picta rerum similtudinibus paulatim virtutis ostenditur, eo quod ex rebus naturalibus, animalibus, moribus et proprietatibus rerum quasi de vivis imaginibus humanæ vitæ qualitas exemplatur. Totus etenim mundus visibilis est schola et rationibus sapientiæ plena sunt omnia. Propter hoc, fili carissime, informativa juventatis tuæ documenta moralia non de nostra paupertate stillantia sed de vena magistrorum tibi nunc scribere cupientes cum adjutorio gratiæ Dei ea trademus, ut intelligas clarius ac addiscas facilius, gustes suavius, reminiscaris tenacius per fabulas figurarum." A glance at the contents of the book will show that the learned author was more concerned with the moral of his fables than with the fables themselves.‡ No attention, except in a few rare cases, is paid to the nature of the animals brought upon the scene, and they are made to utter the most arbitrary and incongruous lessons. A translation of one of

* This singular work has recently been made accessible to scholars by the edition in the *Bibliothek des literarischen Vereins in Stuttgart, Bd.* 148, *Die beiden aeltesten lateinischen Fabelbücher des Mittelalters, des Bischofs Cyrillus Speculum Sapientiae und des Nicholaus Pergamenus Dialogus Creaturarum, herausgegeben von* Dr. J. C. Th. Græsse. The full title is: *Speculum Sapientiae Beati Cirilli Episcopi, alias Quadripartitus Apologeticus vocatus, in cujus quidem Proverbiis omnis et totius Sapientiae Speculum claret.* The book had become very rare and was known chiefly from an old German translation, selections from which were published as late as 1782: *Fabeln nach D. Holtzmann, herausgegeben von* A. Gl. Meissner, Leipzig. 4to. Græsse has given in his edition, pp. 285–302, all the necessary biographical and bibliographical notices.

† Græsse, *ed. cit.*, p. 291, says, "Im Mittelalter selbst kann er von seinen Zeitgenossen nicht benutzt worden sein, denn ich habe nirgendswo in den aus dem 13.-16. Jahrhundert erhaltenen Schriften sein Werk citirt oder benutzt gefunden."

‡ In this respect there is a regular gradation in the three works now under consideration. In the *Speculum Sapientiæ* the moral is the all-important thing, in the *Dialogus Creaturarum* the fable becomes more attractive, while in the *Gesta Romanorum* the story is everything, and the moralization is tacked on merely to justify a sometimes very loose anecdote.

Cyril's apologues will be the best illustration of his peculiarities. We have selected one of the shortest, which is introduced by the sentence, *Uni dilectissimo tantum, cum necesse fuerit, pectus crede.* The Raven and the Dove, Book I, cap. 20. "While a raven was ruminating in his mind to whom he could occasionally communicate the secret of his heart, a dove beholding him thinking these things, approached him, saying: 'What art thou thinking, brother, in such deep meditation?' To whom he replied: 'Verily, I am now thinking that infinite is the number of fools and small indeed that of the wise, for the thought of the heart itself is most secret. For who reveals what he thinks, shows his heart. What, therefore, art thou, that I may give and entrust to thee my heart so precious to me, my most hidden life, my very inmost substance, the most secret root of my being? My secret is mine, because my heart is mine!' Then the dove, having heard these things, added: 'I know, indeed, that thou art cunning by nature. Wherefore I ask thee, brother, to instruct me, to how many and to whom, if it be necessary, I may safely entrust my heart at times.' He soon consenting, willingly said: 'Forsooth, either to one or to none, for perfect faith is seldom found. This, however, is made a very precious vase, for in it the heart is advantageously preserved, because neither of itself is it ever destoyed, nor broken by the sword or other thing, nor is its wonderful solidity transfixed by the most subtle sting of heat. For nature hides the vein of gold in the secret places of the earth, and the plant strikes its quickening root deep in the solid ground. Thus the most precious marrow is hidden in the bones, and God has placed the ice-like gem of sight under the hemispheres of seven veils. No wonder then that the mouth of the wise is hidden in his heart, since this is to him most dear, that thus it may be concealed and, possessed by the heart, hidden in the ark of life. But the heart of the fool is in his mouth, because the mouth rules his heart, and having an open breast despising the heart, it is easily cast forth by a slight breath, wherefore he quickly perishes, since for nothing he casts away the vein of life.' After she had diligently noted these things, the dove thus instructed departed."

The *Speculum Sapientiae*, as we have already said, is of little value for the history of mediæval fiction or the diffusion of popular tales. Scarcely a thing to which the adjective fabulous will apply, is to be found in the work. Grœsse mentions only the story of Gyges (iii, 4), the Indian gold mountains (iii. 10), and the death of the viper (iii, 26; iv, 8, 10), which is found in all the *bestiaires.** Cyril does not seem to be acquainted with Aesop, although the fourth chapter of the first book, *De cicada et formica* is Esopian. There are also some fox fables (e. g. i, 24) which resemble some of the episodes of the *Roman du Renart*, and a number of the fables have a certain similarity to those in well-known collections.†

* See, for example, Dr. G. Heider, *Physiologus*, Wien, 1851, p. 28, and the *Bestiaire de Gervaise* in the *Romania*, i, p. 420, *et seq.*, verse 501.

† Grœsse's references, p. 291, are full of errors: La Fontaine i, 1, = Cyril i, 4; i, 22 = ii, 14 (cp. iii, 13); i, 2 = ii, 15 (the fox praises the singing of the cock, who

Of much greater literary interest, although by no means so profound or original, is the *Dialogus Creaturarum* of an otherwise unknown author, Nicolaus Pergamenus.* The form of this work closely resembles that of the *Speculum Sapientiae;* there is the same apologetic prologue, and the same arbitrary treatment of the subject, but already the desire to interest has assumed prominence, and the fable proper is followed by a mass of sentences, anecdotes, &c. The work contains one hundred and twenty-two dialogues not divided into books. The work, as Græsse (p. 303) shows, cannot be earlier than the middle of the XIV century. The writer, as a glance at the list of authors cited will show, was familiar with the whole range of mediæval literature, including the classic authors popular at that time.† He does not seem any more acquainted than Cyril with the great Oriental collections of fables as such, although separate fables from the Pantschatantra may have reached him through western channels, as Græsse states, p. 304.‡ Instead of the half dozen fables in Cyril's work which may be compared with those of other collections, Nicolaus Pergamenus offers a rich field for the student of comparative storiology, if we may coin a convenient word. The absorption of Oriental elements into literature from oral tradition had already begun, and from literature, as we shall see later on in this article, these elements were to return again to the people, and thus the process was to be repeated over and over again until we are no longer surprised at the marvelous diffusion of mediæval stories.§ An English

thereupon descends from the tree and is devoured); vii, 12 = iii, 4; iii, 17 = iii, 11. His other references are incorrect. We have noticed the following: La Fontaine. ii, 19 = i, 18, 16 (slightly); ii, 11 = i. 18; ix. 4 = ii, 14 (cp. iii, 13). The edition of La Fontaine cited in this article is, *Fables inédites des XII^e, XIII^e et XIV^e siècles, et Fables de La Fontaine rapprochées de celles de tous les auteurs qui avoient, avant lui traité les mêmes sujets, précédées d'une notice sur les Fabulistes, par* A. C. M. Robert, 2 vols., Paris, 1825. This edition will be hereafter cited as Robert, *Fables inédites*, or La Fontaine.

* This work is reprinted in Vol. 148 of the *Stuttgart Litt. Vereins*, mentioned above.

† The list given by Græsse, p. 281, needs careful revision. The following are some of the most necessary corrections: Alfonsus (that is Petrus Alfonsi *Disciplina Clericalis*), *De Prudentia*, 122, add 56; add *Catholicon* 90; add *Nugis philosophorum*, 23, 115; add Martialis, 108 (instead of 109).

‡ It may perhaps be noted here that La Fontaine's well-known fable of *La Laitière et le Pot au Lait* is found in the *Dialogus Creat.*, c. 100. Max Müller (Chips., iv, 170) gives the old English translation of this version, and says: "In it, as far as I can find, the milkmaid appears for the first time on the stage," &c. The version in Jacques de Vitry and Etienne de Bourbon, which will be mentioned later, must be both of them earlier, or as early, and it is probable that in this case, as in so many others, Jacques de Vitry introduced the fable to Europe. A pleasant account of the fortunes of this fable may be found in *Histoire de deux Fables de La Fontaine, leur origines et leurs Pérégrinations, par* A. Joly, Paris, 1877. The other fable is vii, 1, *Les Animaux malades de la Peste.*

§ The following corrections and additions to Græsse's references, p. 304, will be of use to the student. References XXXI, XXXIV, and XLVI belong to XXX, XXXIV and XLVII, respectively; add XLIII, Pauli, 256; the references to XXXVI and XL are incorrect; of the various references given to XLVI (should

translation of the *Dial. Creat.* was published about 1517 and reprinted in a limited edition in 1816.

The third work to be mentioned in this connection is the well known *Gesta Romanorum*. We do not propose in this limited space to approach the still vexed question of the date and nationality of this famous work.* Its importance is not great in the abstract, the number of stories valuable for the *Culturgeschichte* of the middle ages is small, but the part the work has played in the transmission of a vast body of classical and Oriental tales is enormous. Already the morality has been swallowed up in the story, and the aim is to amuse under the pretext of instruction. Other similar collections will be noticed, later out-growths of the homiletic compilations, but the *Gesta Romanorum* stands alone, an independent and original collection, the earliest Occidental effort to throw off the shackles of purely ecclesiastical entertaining literature. The three collections which we have just briefly considered are the only ones intended for the edification of the general reader, and it is only the third which reveals a growing taste that before long was satisfied by Boccaccio and the French *fabliaux*, or by such purely secular collections as the Italian *Cento Novelle antiche*. The mass of material at the disposal of the collector in the XIII and XIV centuries was enormous, besides the vast compilations of legends in the *Vitae Patrum* and *Legenda Aurea*, there were the relics of classical lore, and the new flood of Oriental fiction, both written and oral. In addition to all this, a tendency now shows itself to collect anecdotes, etc., of famous contemporaries. Much of the above material would have perished, and certainly the circle of its influence would have been comparatively narrow, had not a new need made itself felt, and a new market, so to speak, been opened for these wares.

The duty of public preaching, which, at first was reserved for the bishops, was extended later to the priests, but it was for a long time a privilege jealously guarded and restricted to comparatively few. The

be XLVII) La Fontaine, vii, 16, is alone correct; to LXXXIX add *Gesta Rom.*, 29; to XCIII, *Schluss*, add *Gesta Rom.*, 103; the references to C are to three different stories: I "Bird in the hand," *Gesta Rom.*, 467; Kirchhof, iv, 34; II "Dog letting go meat for reflection in water," Pauli, 426; III "*La Laitière et le Pot au Lait*," La Fontaine, vii, 10, Kirchhof, i, 171; the reference to CI. *Gesta Rom.*, 108, is incorrect; both references to CVI are incorrect; of those to CVIII, *Gesta Rom.*, 140, is incorrect, as is also La Fontaine, v, 21; to CX (cp. xliv), La Fontaine, iii, 9, is incorrect; CXII contains two fables: I "*Colombæ et Milvi*," and II "Town and Country Mice," to I belongs Kirchhof, 7, 146, to II Kirchhof, 1, 62, and La Fontaine, i, 9, erroneously referred to CXIII; to CXVII add La Fontaine, iii, 9; to CXVIII, *Gesta Rom.*, 53, instead of 52, other references are incorrect; finally to CXXII add Petrus Alfonsi, p. 83, ed. Schmidt, and *Gesta Rom.*, 31.

*It should seem that little remained to be done after Hermann Oesterley's masterly edition (Berlin, 1872), but the results of his painstaking investigations are chiefly negative. It may be impossible to determine its nationality, but it seems as if more light might be thrown on its age and mode of compilation. The results of Oesterley's studies are given to the English reader in the Introduction to the Early English Versions of the Gesta Romanorum (Early English Text Soc. Extra Series, xxxiii, 1879).

foundation in the XIII century of the two great orders of Dominicans and Franciscans, the former, *par excellence* the *ordo prædicatorum*, gave an enormous impulse to preaching and quite changed its character.* The monks of these orders obeyed literally the words of the Founder of Christianity, and went into all the world and preached the Word to every creature. The popular character of the audiences modified essentially the style of the preaching. It was necessary to interest and even amuse the common people, who, as we have incidentally shown, were becoming accustomed to an entertaining literature more and more secular, and who possessed moreover an innate love for tales. It is chiefly to this fondness for stories and to the preachers' desire to gratify it that we owe the great collections of which we are about to speak. In the composition of the mediæval sermon, which had, moreover, a certain fixed form, the stories, or, to give them the name they then bore, and which we shall use hereafter, *exempla*, were reserved for the end, when the attention of the audience began to diminish.† The value of these *exempla* for awakening the attention and instructing the people is everywhere conceded.‡ These stories are sometimes as long as the rest of the sermon, sometimes, when they refer to a well-known recital, they merely quote the title or a few words of the beginning. The use of *exempla*, properly speaking, is rare before the XIII century (L. de la Marche, p. 276), and was apparently first introduced as a principle by Jacques de Vitry. This eminent prelate and scholar was born in the early part of the last half of the XII century, and took his name either from the village of Vitry on the Seine near Paris, or from a town of the same name on the Marne in Champagne. He studied in Paris from 1180–90, and became a *presbyter parochialis* at Argenteuil near Paris. In 1210 he went to Brabant and became a canon at Villebrouck and afterwards at Oignies, where he was the intimate friend of the enthusiast, Mary of Oignies, whose life he wrote after her death in 1213. From 1210–1217 he preached the crusade against the Albigenses, and took part in the

* The relative importance of these orders may be inferred from the fact that of two hundred and sixty-one French preachers of the XIII century ninety-one were Dominicans and forty-five Franciscans; see Aubertin, ii, p. 308, n. 3.

† In fine vero, debet uti exemplis, ad probandum quod intendit, quia familiaris est doctrina exemplaris, Alanus de Insulis, *Summa de arte prædicatoria*, cap. I, ed. Migne, p. 113.

‡ Herolt in the Prologue to his *Promptuarium Exemplorum* says: "Utile et expediens est viros predicationis officio preditos proximorum salutem per terras discurrendo quærentes exemplis abundare. Hæc exempla facile intellectu capiantur et firmiter memoriæ imprimuntur et a multis libenter audiuntur. Legimus enim principem nostrum Dominicum ordinis prædicatorum fundatorem hoc fecisse. De eo quidem scribitur quod ubicumque conversabatur edificatoriis effluebat sermonibus, abundabat exemplis quibus ad amorem Christi sæculi ve contemptum audientium animos provocabat." Etienne de Bourbon in the Prologue to his treatise, says: "Quia autem ad hec suggerenda et ingerenda et imprimenda in humanis cordibus maxime valent exempla, que maxime erudiunt simplicium hominum ruditatem, et faciliorem et longiorem ingerunt et imprimunt in memoria tenacitatem."

expedition. After the capture of Narbonne in 1217 he was made Bishop of Accon (Acre) in Palestine, where he remained, taking an important part in the crusades. In 1227 he returned to Rome, and between 1228–30 was made a cardinal and Bishop of Tusculum by Gregory IX, who employed him on several missions. He was offered the patriarchate of Jerusalem, but refused it, and died at Rome in 1240.* He is chiefly known by his *Historia orientalis* which extends from 622–1218. We are, however, especially interested in his sermons. We have seen above that he was an enthusiastic preacher of the Albigensian crusade, and Etienne de Bourbon says of him: "Vir sanctus et litteratus * * * prædicando per regnum Franciæ et utens exemplis in sermonibus suis, adeò totam commovit Franciam, quòd non putat memoria aliquem ante vel post sic novisse." His printed sermons (Antwerp, 1575) are what are technically known as *Sermones de tempore et sanctis*, and are distinguished from the mass of sermons of that day by the use of less scholastic argument and more examples borrowed from history and legend. His unpublished sermons (*Sermones vulgares*) are, as L. de la Marche says, literally crammed with stories, and constitute a treasure house which succeeding preachers have pillaged, often without any acknowledgment. L. de la Marche says, p. 276, that each sermon contains three or four *exempla* in succession. The more simple and common the audience the more prodigal he is of his stories. He says himself, in his preface: "The keen sword of subtle argumentation has no power over the laymen. To the knowledge of the Scriptures, without which one cannot take a step, must be added examples which are encouraging, amusing and yet edifying. Let us lay aside the pagan fables and poetry which do not afford any moral instruction; but let us open the door to the maxims of the philosophers which express useful ideas * * * * * * Tha inexperienced who blame this mode of preaching do not suspect the profit it may produce; for our part we have tried it." He then continues relating how he excited the attention of his hearers: "Such an example," he says, "seems dull when read, which, on the contrary, will be very pleasing in the mouth of a skillful narrator." †

* See *Histoire littéraire de la France*, *XVIII*, 209 *et seq.*, Græsse, *Lehrbuch einer allgemeinen Literärgeschichte*, ii. Bd., iii. Abth., ii. Hälfte, p. 1058, and Gœdeke in *Orient und Occident*, i. 541.

† L. de La Marche, *op. cit.* pp, 276–277, who adds: "Les extraits, les reproductions diverses qui furent faites de ses œuvres presque immediatement prouvent combien son idée eut de succès, à quel point elle s'adaptait aux besoins des populations." It was for a long time supposed that Jacques de Vitry was the author of a *Speculum Exemplorum* (see Gœdeke, *op. cit.* p. 542); this is not the case, his *exempla* are found in his inedited sermons. It is greatly to be wished that L. de la Marche who has so ably edited Etienne de Bourbon would do the same for Jacques de Vitry, whose importance for the diffusion of popular tales is greater than that of any writer we shall have occasion to mention in the present article. How much this writer was used by other preachers will appear when we consider later Etienne de Bourbon's obligations to him. Gœdeke in the article above cited mentions another case of wholesale borrowing, that of the monk Johannes Junior in his *Scala coeli*.

Jacques de Vitry was followed by Etienne de Bourbon, whose collections will be examined later in detail, and other writers of this period recommend the frequent use of *exempla*.* The abuses which arose from the excessive use of *exempla* were great, and the Council of Sens in 1528 forbade under the pain of interdict "those ridiculous recitals, those stories of good wives (*aniles fabulas*) having for their end laughter only."† These *exempla* at first were probably collected by each preacher for his own use, then the collected sermons of such celebrated *racconteurs* as Jacques de Vitry offered an inexhaustible magazine for several generations. Finally special collections of these *exempla* were made for the express purpose of aiding the preacher, and it is to these and similar collections that the remainder of this article will be devoted. The wealth of material can be indicated but incompletely in the limited space at our command, and we shall therefore select as illustrations a few typical works from the various classes into which the literature of the subject may be divided. In the first place stand the collections containing *exempla* alone, arranged either alphabetically or topically. We shall make use of one of each class, viz., the *Promptuarium Exemplorum*, and the *Speculum Exemplorum*, and refer briefly to later imitations in the modern languages of these collections. In the second place come treatises for the use of preachers, containing stories systematically arranged, but forming only a part of other homiletic material. Three of these works will demand our attention: Etienne de Bourbon, *De Septem Donis;* Peraldus, *Summa Virtutum et Vitiorum;* and Bromyard, *Summa Praedicantium*. A third source of *exempla* is to

* L. de la Marche, p. 277, cites Humbertus de Romanis, *De Eruditione praedicatorum*. Bibl. Max. Pat. xxv, 433. We have examined all the similar treatises at our disposal, such as Alanus de Insulis, *Summa de arte praedicatoria;* Petrus Cantor, *Verbum Abbreviatum*, and Guibert de Nogent *Liber quo ordine Sermo fieri debeat*, and only in the first named work have we found a brief reference to *exempla* which we have cited above.

† L. de la Marche, p. 278. The reader will recall Dante's passionate outbreak against the preaching of his day (Paradise, xxix, 103-120, Longfellow's translation):

> Florence has not so many Lapi and Bindi
> As fables such as these, that every year
> Are shouted from the pulpit back and forth,
> In such wise that the lambs who do not know,
> Come back from pasture fed upon the wind,
> And not to see the harm doth not excuse them.
> Christ did not to His first disciples say,
> "Go forth, and to the world preach idle tales."
> But unto them a true foundation gave;
> And this so loudly sounded from their lips,
> That, in the warfare to enkindle faith,
> They made of the Evangel shields and lances.
> Now men go forth with jests and drolleries
> To preach, and if but well the people laugh,
> The hood puffs out, and nothing more is asked.
> But in the cowl there nestles such a bird,
> That, if the common people were to see it,
> They would perceive what pardons they confide in.

be found in collections of sermons made for the benefit of idle or ignorant preachers. Two of these collections will be examined: the sermons of Herolt, already mentioned as the author of the *Promptuarium*, and those of Pelbartus of Themesvar; and finally a brief reference will be made to the class of expository works of which one of the most celebrated, Holkot, *Super Sapientiam*, may stand as an example.

The author of the *Promptuarium Exemplorum* was Johannes Herolt, a Dominican monk of Basel, who flourished during the first half of the XV century.* He whimsically called himself *Discipulus*, and his works are generally cited under that name. He himself explains it as follows at the end of the *sermones de tempore*: "Finiunt sermones collecti ex diversis sanctorum dictis et ex pluribus libris. Qui intitulantur sermones discipuli quod in istis sermonibus non subtilia per modum magistri, sed simplicia per modum discipuli conscripsi et collegi." Nothing is known of his life. Besides the works we have already mentioned he left a collection of *sermones super epistolas dominicales*, *Eruditorium Vitae*, a *Quadrigesimale* and a work on the Albigensian war. The *Promptuarium* begins with the usual apologetic prologue from which an extract has been given above, then follow six hundred and thirty-four *exempla* with references to two hundred and eighty-three contained in the sermons. This large mass of stories is arranged alphabetically by topics, *e. g. Abstinentia, Accedia, Adulterium, Amicitia, Acqua benedicta, Baptismus*, etc., and reference is also facilitated by a copious index. Before examining the collection in detail, it may be well to consider briefly its

* Scanty notices of him will be found in Fabricius, *Bib. lat. med.* (Florence, 1858), *sub verb. Discipulus*, Grœsse, *Lehrbuch einer Literärgeschichte*, ii, 2, 1, p. 169, Cruel, p. 480, and Val. Schmidt in his edition of the *Disciplina Clericalis*, Berlin, 1827, p. 99, note 3. The date of the composition of his sermons is given in *Sermo LXXXV (in Dominica secunda post octavas Trinitatis): a Christo autem transacti sunt mille quadrigenti decem et octo anni*, but in the VI of the *Sermones de Sanctis*, he mentions as heretics, Huss, Jerome, and Procopius, the latter of whom did not assume the leadership of the Hussites until 1424, and was not killed until 1434 in the battle of Bœmischbrod. This discrepancy can easily be explained on the supposition that Herolt inserted in his collection his earlier sermons, and either forgot to change the first date or purposely left it (Cruel, p. 480). The collection was probably published between 1435–40, and this will also be the date of the *Promptuarium*, as constant reference is made to it in the sermons and *vice versâ*, and its object was undoubtedly to afford the preachers who used the sermons, a wider range of *exempla*. We do not know whether any edition of the *Promptuarium* appeared separate from the sermons, but imagine not. The enormous popularity of the work (including both in one) may be seen by a glance at Hain and Panzer. The former mentions twenty-nine editions with place and date, and seven without, before 1500; the latter, fifteen editions after the above date. The edition cited in this article is Argentine, 1495, M. Flach, fol. (Hain, No. 8505). It contains the sermons which will be mentioned later, the *Promptuarium*, and a collection of miracles of the Virgin, filling thirty-one pages. There is an old French translation of the *Promptuarium*, *Fleur des Commandements de Dieu*, Rouen, 1496, Paris, 1525, 1536, 1539, and a later arrangement by another Dominican, Aug.-Vind., 1728, 4to, *Discipulus Redivivus*, etc., *collecta a* Bonav. Elers, *Ord. Pr.*

sources, for, as can well be imagined, such a collection could only be a compilation, nor does the author, as we have seen, make any claim to originality.* Herolt himself mentions the following: Arnoldus (Geilhoven *de Roterodamis*, author of *Gnotosolitus sive Speculum conscientiae*); Beda (*Gestis Anglorum*); Caesarius Heisterbacensis (*Dialogus Miraculorum*); Gregorious (Gregory I, *Dialogi*); Gregorius Turonensis; Gulielmus (Thomas Cantinpratensis, *Liber de apibus*); Gulielmus Lugdinensis (Peraldus, whose *Summa virtutum et vitiorum* will be examined later); *Historiis Britonum* (Geoffrey of Monmouth); *Historia ecclesiastica;* Holgot (Robert Holkot whose *Liber super Sapientiam* will be examined later); Hugo de St. Victor; Isidorus; Jacobus de Vitriaco (Jacques de Vitry); *Liber de donis* (Etienne de Bourbon, to be mentioned hereafter); Petrus de St. Amore; Petrus Cluniacenses; Vincentius (of Beauvais, *Speculum historiale*); Viridarius;† *Vitae Patrum* and Zosimas.‡ To this list may be added Jacobus de Voragine whose *Legenda aurea* is frequently used without acknowledgment, and some Oriental sources which will be mentioned later. The ecclesiastical character of Herolt's collection is evident at a glance. The compiler gathered his material largely from a few writers like Caesar of Heisterbach, and does not draw upon his own experience like Etienne de Bourbon. There are only two or three fables, and but few traces of the earlier Oriental collections. The *Disciplina clericalis* contributes four stories: M. 67 = ed. Schmidt, p. 106; S. 5 = Schmidt, p. 46; V. 12 = Schmidt, p. 51; *Sermones de tempore*, 120 = Schmidt, p. 36. There are other Oriental elements as we shall afterwards see, one may be mentioned here, the story in Barlaam and Josaphat, c. 29, which furnished Boccaccio with a well-known tale (Dec. iv, introduc.), is found in Herolt, L. 24. We shall relegate to the notes a few widespread stories in order to show the value of the work for the diffusion of popular tales, and proceed to characterize briefly the more original part of the work.§ Of original historical anecdotes there is scarcely

* Fabricius gives a very incomplete list of Herolt's sources, which is somewhat increased by Mansi in the Florentine edition of 1858.

† We are not acquainted with this work, but the *Speculum exemplorum* cites a work, *Viridarium sanctorum ex Menaeis Graecorum translatum*. We must confess and deplore our distance from a large library of reference, which prevents our settling some doubtful points in the present essay, the materials for which are drawn almost exclusively from our own private library. Our thanks are, however, due to the library of the Auburn (N. Y.) Theological Seminary which, with the utmost liberality, put at our disposal its copy of Migne's *Patrologia*.

‡ Of the above, Arnoldus, Cæsarius, Gregory, Gulielmus (Cantinpratensis), and the *Vitæ Patrum* furnish about two hundred exempla or nearly one-third of the whole.

§ A. 13 B (Pauli, 200); A. 15 (*Gesta Rom.* 188); A. 18 (Pauli, 93); B. 9 (*Gesta Rom.* 45); C. 32 (*Gesta Rom.* 48); C. 39 (*Leg. aurea* 142); C. 40 (Pauli, 278); D. 3 (Pauli, 546); E. 5 (Pauli, 140); E. 6 (Wright's Latin Stories, 65); E. 12 (*Wendunmuth* 5, 127); F. 2 (Pauli, 391); F. 6 (Pauli, 683); F. 15, 16 (Pauli, 436); F. 17 (Pauli, 435); J. 16 (Pauli, 692); I. 33 (Pauli, 647); I. 38 (Pauli, 129); I. 39 (Pauli, 507); I. 40 (Pauli, 226); I. 41 (Pauli, 118); I. 42 (Pauli, 125); I. 43 (Pauli, 124). I. 44 (Pauli, 186); I. 49 (La Fontaine, Bk. I. 7); L. 3 (Pauli, 337); L. 21 (*Wendunmuth* I. 220); L. 35 (Pauli, 385);

an instance (A. 6; P. 123, 124). Comparatively little can be learned of the fashions of the day, a rubric so full and extensive in Etienne de Bourbon. In the eighty-third *Sermo de Temp.* (*De superbia vestium*), the long trails of the ladies of that time are bitterly censured, and a story told which is probably taken from Caesar of Heisterbach (Dial. V, 7, cp. Kaufmann's *Caesarius von Heisterbach, 2te, Aufl.* Cöln, 1862, pp. 40, 41, 114). The remainder of the stories, *i. e.*, those which may be regarded as original, so far at least as no source being cited—are the ordinary monkish tales, of which there must have been an enormous mass in circulation, and of which the best idea may be formed by a perusal of Caesar of Heisterbach's *Dialogus Miraculorum* (ed. J. Strange, Cologne, 1851. 2 vols.) From this hasty survey we see that Herolt's work does not possess the interest and value we should expect. It gives, it is true, a very complete picture of the low intellectual level of preacher and congregation, and so far is important, but it fails to reproduce the society of the day as is so vividly done in Etienne de Bourbon, for instance. The most valuable part of Herolt's collection is what he borrowed from others, and to which he gave a wider circulation, and this constitutes his chief interest for the student of comparative storiology.

The *Promptuarium*, as we have seen, was an appendix to the author's collection of sermons and intended to be used in connection with them. It was not long before some one conceived the idea of making an independent collection of *exempla* which could be used with any of the numerous sermon-books. The most famous of such independent collections is the *Speculum Exemplorum.** The author's name and country are unknown, but from internal evidence he seems to have been from the Low Countries or the adjacent German provinces. The popularity of his work led a Jesuit of Duaci, Johannes Major, to remake the book by casting it into an alphabetical form and by a very free handling of the contents. He terms his work *Magnum Speculum Exemplorum*,† and justifies this name in his preface by saying it surpasses all previous collections in the number of its *exempla*, which the compiler states to be thirteen hundred and seventy-five. The source of the story is always given at the end, and there is an attempt at a bibliography of similar collections. The growing scientific spirit of the day is very amusingly illustrated in the preface, where an apology is made for the apparently incredible character of some of the stories, which, however,

M. 3 (Pauli, 81, 90); M. 17 (*Wendunmuth* I, 366); M. 18 (Pauli, 135); M. 22 (*Libro de los Enxemplos*, 23; *Romania*, No. 28, p. 497); M. 30 (*Gesta Rom.*, 273); M. 68 (*Gesta Rom.* 202); O. 12 (Pauli, 318); O, 13 (Pauli, 318); O, 14 (Pauli, 317); O, 23 (*Wendunmuth* 7, 17); P. 2 (Pauli, 471); P. 4 (Pauli, 471); S. 10 (Wright's Latin Stories, 84); T. 5 (Pauli, 281); T. 8 (*Wenduumuth* 2, 137, La Fontaine Bk. VIII, 2); T. 9 (*Wendunmuth* 2, 137); V. 14 (Pauli, 11); V. 41 (Pauli, 305); Y. 4 (Pauli, 665)?

*The first edition was printed at Daventer, in Holland, in 1481 (Hain, No. 14915), then followed editions of Cologne, 1485, Strasburg, 1487-90-95-97, and Hagenau, 1507-12-15-19.

† Duaci, 1605-7; Antwerp, 1607; Cologne, 1611-72. Our copy is Duaci, 1607. We have not been able to procure a copy of the original work.

if closely examined, will be seen to be possibly true, *e. g.*, the story of the obstinate woman thrown into the water, who could not speak but moved her fingers to represent a pair of scissors—here the collector naïvely adds: "Potuit enim daemon cuius rabiosa illa foemina praeda erat, ipsius articulos in eam formam composuisse." The increasing secular character of these works is indicated by another passage in the preface: "Deinde si qua incredibilia, vel fabulosa, vel tantum ad ciendum risum efficta videntur, qualia paucissima sunt, solum in navigiis, vehiculis, mensis vel iucundis congressibus narranda serventur." The scope of the work has been enlarged, it is no longer addressed exclusively to preachers, but to the "prudens concionator, cathecista vel narrator." We think we can also notice a distinct advance in the character of the stories; more historical incidents are introduced, and the number of puerile monkish stories is much smaller. Our space will not allow us to examine in detail this vast compilation; many of the stories in the *Promptuarium* are to be found in it, and it must have served to spread many stories at a time when the taste for the older collections was rapidly diminishing.* This is perhaps the most appropriate place to describe several collections in the vulgar tongues, which, so far as their scope goes, are purely secular. We mention these works here rather than in connection with the *Gesta Romanorum*, because they seem to us more appropriately classed here by their form. They are alphabetical, or arranged topically for convenience of ref-

* A work similar to the *Speculum Exemplorum* is, A. Davroult, Soc. Jes., *Flores exemplorum, in quo Fides Catholica poene innumeris et exemplis sanctorum, et vivorum illustrium probatissimis confirmatur.* Coloniæ, 1636, 1686, 4to. Other works of this class might be mentioned here, but we will merely call the attention of scholars to two collections of mediæval moralized tales described by the Vice-President of the Royal Irish Academy in a paper read before that body, April 10, 1882, and entitled, "On two Collections of Mediæval Moralized Tales," by John K. Ingram, LL.D., F. T. C. D., Dublin, 1882. These collections are found in MSS. belonging to the Diocesan Library of Derry. The first is in two parts, one containing *exempla* arranged topically; the other is arranged in alphabetical order, "and the subjects are illustrated not by stories or anecdotes, but by sentences quoted apparently from various authors." The second is entitled, *Speculum sive lumen laycorum.* The arrangement is alphabetically by topics. I cannot do better than quote Dr. Ingram's account of the sources used by the compiler. "The materials of the work are borrowed from a great variety of authors. The classical writers of antiquity are but little quoted; there are references to Aristotle—some of whose works were known through Latin versions—to Cicero, Horace, Valerius Maximus, and Seneca. But the sources on which the compiler has drawn most largely, are the writings of St. Augustine, especially the *De Civitate Dei*, the *Historia Tripartita* of Cassiodorus, the Dialogues of St. Gregory, the collection known as *Vitæ Patrum*, the curious treatise entitled *Barlaam and Josaphat*, various Lives of Saints, the *Disciplina Clericalis* of Petrus Alfonsus, and the works of St. Isidore of Seville, of Bede, of Jacobus de Vitriaco, of Peter of Clugny (otherwise known as Peter the Venerable), and of Jacobus de Voragine, author of the *Legenda Aurea.* * * * Some of the narratives appear to have been taken, not from books, but from popular rumor or tradition, commencing as they do with *Fertur* simply. In the moralizations very large use is made of the Old and New Testament, with the text of which the compiler seems to have been thoroughly familiar."

erence. They are, of course, all outgrowths of the same spirit, but the works now under consideration, we think, owe more to the distinctively ecclesiastical collections than to the *Gesta Romanorum*. In 1860, Don Pascual de Gayangos edited for Rivadeneyra's *Biblioteca de Autores Españoles*, a volume (No. 51) of *Escritores en prosa anteriores al siglo XV*, pp. 447–542 of which contain *El Libro de los Enxemplos*, an alphabetical collection of three hundred and ninety-five stories. As the stories, however, begin with C (*Confessio devota debet esse et lacrymosa*) it is evident that the first part of the collection is wanting. This loss was repaired by A. Morel-Fatio who discovered the missing stories, seventy-one in number, and published them in the *Romania*, vii, pp. 481 *et seq.* The compiler was a certain Clemente Sanchez, Archdeacon of Valderos, in the diocese of Leon.* His chief sources are the *Disciplina Clericalis*, which he has incorporated almost entire in his work, *Vitae Patrum*, Dialogues of St. Gregory, and Valerius Maximus. The four furnish nearly one quarter of the whole number of stories. About twenty are taken from the *Gesta Romanorum*, or, at least, are found in that collection; many others are taken from the *Legenda Aurea*, and mediæval chroniclers. The number of stories referring to Greek and Roman history, or taken from classical sources is noteworthy. Each story is preceded by a Latin title which is translated in a Spanish distich which follows, and generally rhymes. The second of the alphabetical collections in a modern tongue is in the dialect of Catalonia, and was made prior to the XV century, or in the early years of the same.† The first volume, all published at present, contains three hundred and seventy stories, ranging from A to K. The stories are preceded by a Catalan title (not alphabetical) which usually mentions the source, then follow short Latin titles arranged alphabetically. The principal sources are: Jacques de Vitry, *Vitae Patrum*, Caesar of Heisterbach, Helinand, Valerius Maximus, Petrus Alfonsi, Etienne de Bourbon, *Legenda Aurea*, St. Gregory and Petrus Damianus. These alone furnish two hundred and forty-five stories, and afford a very clear idea of the general character of this collection. ‡

We have thus traced rapidly this curious branch of our subject. Originally merely an appendix to a collection of sermons, then forming an independent work by themselves, but still with the purpose of furnishing the preacher with entertaining matter for his homilies, these stories finally

* See *Romania*, *loc. cit.*, and Nic. Antonio, *Bib. hisp. vetus*, ii, 208.

† *Recull de Eximplis e Miracles, Gestes e Faules e altres ligendes ordenades per A-B-C, tretes de un manuscrit en pergami del segle XV, ara per primera volta estampades* (no place or date, in fact, Barcelona, 1881, A. Verdaguer).

‡ Some extracts from a collection of edifying stories found in a Portuguese MS. of the XIV century have recently been published by J. Cornu in the *Romania*, xi, pp. 381–390. The stories, twenty-four in number, are drawn from the Bible, St. Gregory, the *Vitae Patrum*, etc. No. 9 is the famous parable of the Friends in Need (Barlaam and Josaphat, cap. 13, see *Gesta Rom.* ed. Oesterley, cap. 238). The stories are not alphabetically arranged, and no hint is given of the extent of the original work.

became, in their more modern dress, a pastime by no means unprofitable, for besides introducing secular elements into entertaining literature, they contributed to prepare the ground for the Revival of Letters by diffusing some remnants of classical lore. The general question of the bearing of these collections upon the subject of the diffusion of popular tales will be considered at the conclusion of the present article.

We have now to direct our attention to the class of treatises for the use of preachers containing *exempla* systematically arranged, but forming only a part of other homiletic material. In many respects the most interesting and valuable work of this class is the *Tractatus de diversis materiis praedicabilibus, ordinatis et distinctis in septem partes, secundum septem dona Spiritus sancti et eorum affectus, currens per distinctiones materiarum, per causas et effectus, refertus auctoritatibus et rationibus et exemplis diversis ad edificationem pertinentibus animarum*, by Stephanus de Borbone, usually cited as the *Liber de Donis* (in the *Recull de Eximplis* as *Libre de Dono Timoris* for a reason which will hereafter be apparent).* The author of this work was careful to conceal his name, and designates himself in the prologue simply as: "Ego, frater S., in ordine Fratrum Praedicatorum minimus." From a brief notice in the *Scriptores ordinis prædicatorum* (I, 184), it appears that the author was a certain Stephanus de Borbone (Etienne de Bourbon), born at Belleville-sur-Saône (department of the Rhône), a member of the Dominican order, who died about 1261 in a monastery of his order at

* Copious extracts from the above work have been published under the title, *Anecdotes historiques, Légendes et Apologues tirés du recueil inédit d'Etienne de Bourbon, dominicain du XIIIe siècle, publiés pour la Société de l'Histoire de France par* A. Lecoy de la Marche, Paris, 1877. The plan of the edition is thus stated by the editor in his introduction, p. xxv: "On ne trouvera pas non plus ici le texte intégral de tout le volumineux manuscrit d'Etienne de Bourbon; mais on y trouvera du moins un texte pur, et plus que des extraits. J'avais à faire un volume de documents historiques; j'ai donc pris tout ce qui pourait intéresser l'histoire, c'est-à-dire la plus grande et la meilleure partie de l'ouvrage, et, pour ainsi dire, sa moelle. En un mot, j'ai laissé de côté les réflexions morales, les passages de l'Ecriture et le commentaire théologique, n'en gardant que ce qui était indispensable pour faire comprendre le plan et la pensée de l'auteur, pour rattacher ensemble sa longue série d'examples, dont je ne pourais songer à intervertir l'ordre. Quant à ces examples eux-mêmes, j'ai dû en supprimer également un bon nombre, qui auraient grossi inutilement et démesurément ce volume. Voici la régle générale que j'ai suivie à cet égard: tout ce qu'Etienne a raconté *de visu* ou *de auditu*, c'est-à-dire ce qui s'est passé de son temps, et les faits antérieurs, authentiques ou légendaires, dont il a recueillé un récit oral, tout cela a été soigneusement conservé; les traits empruntés par lui à d'autres écrivains, ordinairement désignés, c'est-à dire la partie de son recueil qui n'est pas véritablement originale, ont été sacrifiés. Je n'ai fait que de rares exceptions, commandées par des raisons spéciales. Ainsi, je n'ai pas cru devoir rejeter les citations de certains auteurs contemporains de nôtre, et dont les écrits sont peu ou point connus; les historiettes assez nombreuses tirées de la collection de Jacques de Vitry, par example, ne pouvaient qu'ajouter un attrait de plus à l'édition." The notes to the separate stories are not as full as might be desired, and some of the most interesting parallels have been overlooked; some additions to these notes will be given when we consider the contents of the work.

Lyons. Further details are furnished in his work itself (L. de La Marche, pp. iv. *et seq.*). He studied at the University of Paris, and relates some interesting stories of student life (c. 360). He probably entered the order of St. Dominick at Lyons, where he became well acquainted with the Waldensian heresy. Like most of his order, he became a missionary, and preached the crusade against the Albigenses, as L. de la Marche says, probably at the time of the expedition of Louis VIII, in 1226. He was made an inquisitor by the Pope, and gives many curious anecdotes about his way of dealing with heretics. His long life, for he must have been nearly seventy at his death, was spent in the discharge of the busy duties of his office, which took him on frequent missions, some of which have left their traces in his work. One of the objects of the book, like those already mentioned, was to furnish preachers with *exempla*. These he does not give separately, and in alphabetical order, but incidentally in the course of a treatise on the seven gifts of the Holy Ghost (Isaiah xi. 2, 3): *Timor, Pietas, Scientia, Fortitudo, Consilium, Intellectus,* and *Sapientia,* whence the usual title *Liber de Septem Donis.** Each of the seven parts is divided into *tituli,* these again into chapters. Unfortunately, the learned author was overtaken by death in the midst of his fifth division (*Consilium*). In the prologue he conscientiously cites his authorities, and an interesting list it is, giving an excellent idea of the state of learning at that day. The editor notices the comparatively few classic authors cited; on the other hand, Etienne de Bourbon was perfectly acquainted with the whole range of mediæval theology, and borrowed freely from the *exempla* contained in the sermons of Jacques de Vitry. The editor roughly divides the *exempla* in Etienne de Bourbon into two classes: First, those taken from previous writers, historical works, sacred or profane, theological compilations, lives of the saints, legends, poetry, fables, etc.; secondly, those borrowed from events contemporaneous with the author, from his own recollection or that of his friends, and from traditions communicated to him by word of mouth. We shall follow, in the main, these divisions and mention first those stories which have no historical value, but are of importance for comparative storiology, indicating by means of his initials those which are borrowed from Jacques de Vitry.

First, fables and apologues: No. 43,† the son who bit off the nose of his father who had trained him up so badly that he ended his life on the gallows (Pauli, No. 19);‡ No. 225 (J. de V.), the traveler and the viper

* The MS. used by Lecoy de la Marche for his edition is that of the *Bibl. Nat., fonds lat.* 15,970. The work is reprodnced in a mutilated form in other MSS, mentioned by the editor, p. xxii. These contain generally mere *résumés* not extending further than the first division of the subject (*de dono Timoris*) hence the title applied to the work in the Catalan collection above mentioned.

† These numbers refer to the divisions introduced by the editor for convenience of reference, and which generally correspond each number to one *exempla*.

‡ In order to economize space, we refer where possible to the corresponding stories in Pauli, *Schimpf und Ernst*, Stuttgart, Litt. Ver., Bd. 85, and Kirchhof's *Wendunmuth*, same series, Bde. 95-99. These two works are edited by Hermann Oesterley, who has added the most exhaustive references to each story.

(Kirchhof 7, 73; Æsop ed. Furia CXXX; La Font. vi, 13); No. 271 (J. de V.), the milk-maid and the pot of milk (Kirchhof 1, 171; La Font. vii, 10; Max Müller, Chips, iv, 170; Joly, *Deux Fables*, etc., p. 91); No. 291, the mule boasting of his descent, "the horse is my grandfather" (cp. La Font. vi. 7; *Disciplina clericalis*, ed. Schmidt, p. 41; Pauli, No. 170; (Kirchhof 4, 138); No. 297 (J. de V.), the bat pretending to be a bird (La Font, ii. 5; Aesop ed. Furia, CXXV); No. 375, True and Untrue, the apes tear to pieces the one who tells them the truth (Pauli, No. 381; Phaedrus, app. 24; Robert, *Fables inéd.* ii, 547); No. 376, lion, wolf, and fox dividing prey; wolf takes better part, and lion tears off the skin of his head, the fox when asked who taught him to make a better division, replied, "He to whom you gave a red cowl" (Kirchhof 7, 24); No. 409 (J. de V.), the cobbler and the rich man (Kirchhof 2, 137; La. Font. viii. 2); No. 451 (J. de V.), the old man and his two mistresses, one pulls out his white hairs, the other, his black ones (Kirchhof 6, 67; Aesop ed. Furia, CXCIX).

The following list embraces all the legends and stories of general interest: No. 37, legend of the Knight in the Chapel (Köhler, *Jahrb. für rom. und eng. lit.*, vi, 326); No. 46, archdeacon who killed the bishop (*Miracles de Nostre Dame*, Paris, 1876, i, 101; cp. D'Ancona, *Sacre Rappresentazioni*, Florence, 1872, ii, 445); No. 81, the prince who bought for much money the advice: *In omnibus factis tuis considera antequam facias, ad quem finem inde venire valeas;* which maxim written on all the royal linen, etc., saves the king's life by terrifying the barber who had been bribed to kill him (cp. *Gesta Rom.* c. 103, for a more complete version, which is also found in several Italian popular tales: Gonzenbach, *Sicilienische Märchen*, 81; Gradi, *Pasqua di Ceppo*, p. 83); No. 130, a version of the Crescentia legend (D'Ancona, *Sacre Rappresentaz*, iii, 199); No. 143, the *fabliau De Brunain la vache au prestre* (Méon iii, 25; Luzel, *Légendes chrétiennes de la Basse-Bretagne* I, 30); No. 160, legitimate son recognized by refusing to shoot an arrow at the body of his dead father (*Gesta Rom.* 45; Wright's Latin Stories, No. 21); No. 161, a version of Bernier's *fabliau* of *La Housse partie* (Méon iv, 472; Von der Hagen, *Gesammtabenteuer* ii, p. lv, No. 48; Pauli, 436); No. 168, the legend of Robert the Devil (Græsse, *Literärgeschichte* ii, 2, 2, p. 628; Douhet. *Dictionnaire des Mystères, ad verb.*); No. 173, a version of the Alexis legend (*Gesta Rom.* 15); Nos. 176–178, the legend of Theophilus (D'Ancona. *op. cit.* ii, 445; Græsse, *op. cit.* ii, 2, 2, p. 625); Nos. 242–244 (J. de V.), examples of woman's obstinacy (Pauli 595; La Font. iii, 16; Dunlop's *Geschichte der Prosadichtungen uebertragen von* F. Liebrecht, Berlin, 1851, pp. 207, 274); No. 245, a long story of an old woman who makes mischief between husband and wife (Kirchhof 1, 366; Wright's Latin Stories, 100; *Promptuarium Exemp.*, M. 17); No. 246, dish of tongues good and bad (*Vita Aesopi*, Bromyard, *Summa praedicantium* L, 5, 5, Kirchhof 3, 129; a similar story is found in the Talmud, see Levi, *Parabole*, etc., Florence, 1861, p. 398, *La Lingua*); No. 248 (J. de V.), story of nun who tears out her eyes and sends them to

king who had fallen in love with her beauty (this story is taken from the *Vitae Patrum*, ed. Lugd. 1616, *lib.* x, *cap.* 60); No. 298 (J de V.), curiosity detected by putting a bird in a covered dish (Pauli, 398); No. 331, the famous apologue of the three rings employed by Lessing in his *Nathan der Weise* (*Gesta Rom.* 89); No. 338, Jew converted by seeing the Christian religion withstand the evil examples of its professors (Boccaccio, Dec. i, 1, see M. Landau, *Die Quellen des Decamerone*, Wien, 1869, pp. 65, 148); No. 339 (J. de V.), man carrying lamb to market is made to believe it a dog by three sharpers (for this famous Oriental story see Oesterley's references to *Gesta Rom.* 132, Pauli, 632); No. 370, the legend of the faithful hound (D'Ancona, *Il Libro dei Sette Savy di Roma*, Pisa, 1864, p. 103, a Chinese Buddhist version is given by S. Beal in the Academy, Nov. 4, 1882 (No. 548), p. 331, "Bedd Gelert;" we shall revert to this story later); No. 373, Schiller's *Der Gang nach dem Eisenhammer* (*Gesta Rom.* 283); No. 396, Parnell's Hermit (*Gesta Rom.* No. 80, this legend has also become a popular tale: Gonzenbach, *op. cit.* No. 92; De Trueba, *Narraciones populares*, p. 65; Luzel, *op. cit.* i, 282, ii, 4); No. 414, treasure in trunk of tree (*Gesta Rom.* No. 109); No. 433 (J. de V.), story of innkeeper who used to tip over his customers' wine, saying: "*Hoc significat, abundanciam que veniet vobis, et bonam fortunam.*" A certain pilgrim to whom this had been done, privately opened the spigot of a cask, and repeated the above words to the angry host (Pauli, 372; *Novellette di San Benardino*, No. 29); No. 436 (J. de V.), a woman wishing to obtain access to a bishop in order to demand justice is told she must grease his hands (in the French sense *se faire graissir la main*), and follows the injunction literally (Pauli, 124); No. 460 (J. de V.), the famous story technically known as the Matron of Ephesus (D'Ancona, *Il libro dei sette savj di Roma*, p. 118, *Studi di Critica*, Bologna, 1880, p. 322; Griesebach, *Die treulose Wittwe*, Vienna, 1873); No. 494, the legend of the wood of the Cross (see A. Mussafia, *Sulla legenda del legno della Croce*, Vienna, 1869; W. Meyer, *Die Geschichte des Kreuzholzes vor Christus*, München, 1881); No. 502 (J. de V.), the stratagem employed by Sancho Panza while governor (Don Quixote, ii, 45) to discover whether a young man had done violence to a certain woman (Wright's Latin stories, No. 20); No. 507, a tradition of Homer who was forbidden to enter the king's palace while he wore a mean garb, but clothed in a rich dress was honorably received and obtained what he asked; instead of thanking the king for the favor, he thanked his clothes (the story is told of Dante, Papanti, *Dante secondo la tradizione e i novellatori*, Livorno, 1873, p. 72. This story, too, has become a popular tale, and is related of the typical Sicilian booby, Giufà, see Gonzenbach, *op. cit.* i, 258).

Turning now to the class of popular superstitions, we shall find much that is interesting as illustrating the condition of society at that day. The belief in the divination of the cuckoo seems to have been widespread. A story is told of an old woman (No. 52), who heard on the first of May a cuckoo singing five times, and believed she would live at least that num-

ber of years more. On her dying bed she refused to confess, saying it was unnecessary as she should live five years, and when she grew too weak to speak she uttered the sound of the cuckoo five times, and finally held up her five fingers and died (Pauli, 289). In regard to unfavorable omens, Etienne de Bourbon cites a story from Jacques de Vitry about a king of Castile, who, while advancing against the Saracens, met a flock of crows. Some of the soldiers urged the king to return, but he very sensibly said that the crows were not older than four years, whereas he had fought more than twenty against the Saracens, and knew more about the way to fight them than the crows did. He advanced and beat his enemies (No. 353). In another story (No. 355), from the same source, an innkeeper detained a countryman in his tavern by making a noise with a bladder which the latter said was a bad omen. Fortune-tellers flourished then as now—one had a house divided into several parts, in one of which he received those coming to consult him, but overheard from an adjoining part what they said among themselves. The inquirers were then led by a round-about way to that very part where the diviner addressed them by name, and answered their questions (No. 357). Another fortune-teller, an old woman, sent her son to steal the cattle of a rich peasant who lived at some distance, and tie them to a tree in the forest. The owner was then told by the son that in a certain town there was a good fortune-teller, who could inform him where his cattle were. This the old woman did, and earned great fame thereby (No. 358). The most interesting story of this kind, however, is one describing an event of which Etienne himself was an eye-witness (No. 360). We give it in his own words: "When I was a student in Paris, on Christmas Eve, while our companions were at Vespers, a certain notorious thief entered our lodging, and opening the room of one of our comrades, carried away several volumes of law books. When the owner wanted to use them after the holiday, he found they were gone, and hastened to the fortune-tellers (*malificos*). After many had deceived him, one conjured up some evil spirits and made the student look into a mirror, in which he saw, among other things, that a certain comrade of ours, a relative of his, and whom we believed the most honest of our number, had stolen his books. The owner accused him of the theft not only among the students, but also among his friends. When, however, the aforesaid thief had stolen some other things, and had been detected, he took refuge in the belfry of a church, and told every one who asked him, what he had stolen, and where it was. After some students who lived near us had discovered in this way a wallet (*mantica*), which had been stolen, the one who had lost his law books reluctantly consented to go to the thief, and inquire about them. The thief told him when and where he had stolen them, and designated the dwelling of the Jew to whom he had pawned them, and where the owner found them." Even the clairvoyants of the present day have their counterparts in the old women who had the dresses or girdles of the sick brought them, in order to divine the diseases of the owners (No. 363). These were also the days of witchcraft (No. 364, 366, 367),

and the Wild Huntsman whose band was known as *familia Allequini vulgariter vel Arturi* (No. 365).* Many anecdotes of this kind came to the knowledge of Etienne while searching for heresy in the south of France. It is to his credit that he did not put much confidence in these absurd stories, although fortunately he deemed them worthy of preservation. We have already mentioned the story of the faithful hound, Bedd Gelert, which is of Oriental origin, and is found, for instance, in the Seven Wise Masters. After giving a version of this story, which has become in several places a local legend, Etienne proceeds to say that the dog was considered a martyr, and its grave was visited by the sick just like the shrines of wonder-working saints. Sick children especially were brought to the place, and made to pass nine times through an aperture formed in the trunks of two trees growing over the hound's grave, while various Pagan rites were performed, and the child was finally left naked at the foot of the tree until two candles an inch long were consumed. Etienne, by virtue of his office as inquisitor, had the dog exhumed, its bones burnt, and the grove cut down (No. 370). In this connection we may mention the dances which incur the writer's ire. He says the devil is the inventor, guide and advocate of the dancers (No. 461), and adds that there once appeared to a certain holy man the devil in the shape of a little Ethiopian standing over the woman leading the dance, and guiding her about as he wished, and leaping over her head (*ibid*). Etienne derives the origin of dancing from the worship of Apis (*ibid*), and narrates several examples in which dancers were punished by the floor breaking through under them, and the church in which they were performing this incongruous act being struck by lightning (Nos. 462–63). These dances in the church, or rather, before it, and in the neighboring cemetery are frequently mentioned by our author. In Roussillon the feast of the patron saint was celebrated by the young people making and mounting a wooden horse, and dancing in the church and cemetery (No. 194). Sometimes the officiating priest was disturbed by these dances, and came out and broke them up very unceremoniously, as, for instance, a certain Master Stephanus de Cudo (Cudot), who, when he could not otherwise stop the throng, seized the *peplum* of the leader, a *majorissa* of the town, and pulled it off together with all her hair and the ornaments of her head (No. 275), a not unlikely proceeding as we shall see in a moment. Luxury in dress has always been a favorite subject of denunciation from the pulpit, and some of Etienne's stories prove that there is a greater permanence in fashion than we usually imagine. Blond hair seems to have been as popular in the XIII as in the XIX century, and the length of ladies' trains seemed then an invention of the devil. We have just seen how a priest put an end to a dance by pulling off the leader's mantilla, and with it her false

* A counterpart to this myth is that of the *bonnes choses*, or *bonesozes* (see L de la Marche's note to No. 97), women who supposed that they accompanied at night Diana or Herodias mounted on certain beasts and traversed wide spaces of the earth and air.

hair—an incident that occurs more than once in Etienne's pages. One Palm Sunday, while the procession was passing the window of a wealthy clerk, a pet monkey descended by its chain, and snatched off the wig of an old woman, and then climbed back displaying his trophy in great glee, Etienne happening to be in the procession when this occurred (No. 274).* Painting the face was likewise common and liable also to shameful detection, as where a mountebank filled his mouth with water and blew it into the painted face of a woman with a result that can easily be imagined (No. 279). A more delicate trick was that of a magnate who made a hole in a cushion, and blew the feathers in the face of a lady sitting near him ; when she discovered the feathers sticking to her face she tried to rub them off, but only made matters worse, until at last she looked like an image that had undergone repairs, "*ad modum imaginis reparate*" (No. 280). The pointed shoes of this period, as well as the women's long trains, were favorite resorts of the devil. A woman who had been dancing for some time could not move her feet for several days, at last they cut off the points of her shoes, and out came the devil with a noise, and the woman recovered (No. 281). Etienne repeats (No. 282) a story of J. de Vitry's, who says a certain holy man once saw the devil laughing, and asked him the reason. He was told that one of the devil's companions was accustomed to ride about on a lady's train, and when she lifted her dress at a muddy spot the devil fell off into the mire.† The costliness and weight of women's girdles or belts also called for reproof. They were made of iron, silk, silver or gold, and adorned with precious stones ; some were ornamented with the figures of lions and dragons, and birds wrought in gold and silver, the workmanship of which was more costly than the material. They were so heavy that the wearers would refuse to carry in penance about their waists an equal weight in lead or iron.‡

Our space will not permit us to examine at equal length the class of historical anecdotes or those related by Etienne as an eye-witness. A very complete and vivid picture of society might be drawn from this work : the schools, the streets of Paris, the open-air preaching, the crusade against the Albigenses, Saint Louis and his crusade, in short, the civil, ecclesiastical, and military life of the day are unrolled before us, while the theologian or church historian will find valuable materials in Etienne's detailed account of the heresies of that time (pp. 290–314).

* Bourgain, *La Chaire française*, p. 12, n. 4, cites the following passage from Hugues de Saint-Victor, which will illustrate the above *exemplum*: "(Simiam) que licet villissimum et turpissimum et horrendum sit animal, tamen heu! maxime clerici in suis domibus hanc habere et in suis fenestris ponere solent, ut, apud stultos qui pertranseunt, per ejus aspectum gloriam suarum divitiarum jactitent."

† Cæsar of Heisterbach, *Dial. Mirac.* v, 7, says that an honest citizen of Mainz saw a multitude of devils on the train of a lady of that city. "They were small as mice, black as Ethiopians, laughing and clapping their hands and jumping about like fish in a net."

‡ For further details of this kind see L. de la Marche, *La Chaire française*, pp. 404, 412.

The second work of the class of treatises which we shall notice is the *Summa Virtutum ac Vitiorum* of Gulielmus Peraldus, also a Dominican and bishop of Lyons.* He died in 1275, leaving besides the above work a large number of sermons. The *Summa*, which is quoted by both Herolt and Etienne de Bourbon, is, as its name indicates, a treatise on the principal virtues and vices, forty of the former and forty-one of the latter being considered in detail. For convenience of reference the work is supplied with very full indices and analytical tables of contents. The *exempla* no longer have the importance attributed to them in the works we have already cited, and when they are used for purposes of illustration, they are given in a dry, brief way. For example, under the head of *Invidia* (Vol ii, p. 281), Peraldus cites a well-known story as follows: "Exemplum de quodam rege, qui concessit cuidam avaro et cuidam invido munus quod eligerent, ita tamen quod munus ejus qui posterior peteret, duplicaretur: et cum uterque differet, præcepit rex invido ut prius peteret: qui petit ut eruetur sibi unus oculus, volens quod proximo eruerentur ambo." † Although Peraldus's work possesses but little of the interest of the work last discussed, it is still valuable. The writer was a learned man, and cites not merely the Christian authors popular during the middle ages, but quotes constantly from the classics, From his pages may also be gleaned many details of mediæval society.‡

The most extensive and in many respects the most valuable of all the works of the class we are now examining is the *Summa Praedicantium* of John Bromyard, an English Dominican.§ He was from Herford, and became a celebrated theologian and jurist at Oxford. He was afterwards professor of theology at Cambridge, and is said to have been one of Wicliff 's opponents in the Council of London, 1382. He died in 1418,

*The first edition is Cologne, 1479. It has been frequently reprinted since; our copy is Cologne, 1629, two volumes, 4to.

† As this story, which is of Oriental origin (see Benfey, Pantschatantra, i, 498, 504), is found in three of the collections we are examining, we have an opportunity to compare its treatment by the various compilers. Herolt, *Prompt, Ex.* I, 33, is almost as concise; Bromyard, I, 6, 19, is a little more diffuse; Holkot, *Super Sapientiam, lect. XXIX*, gives the story as follows: "Narratur de quodam cupido et invido insimul iter agentibus quod vox de celo venit ad eos dicens: Petat unus quidquid voluerit et habuerit, sic tamen quod socius ejus habebit duplum. Fit contraversia quis eorum prius peteret. Tandem invidus: Peto, inquit, ut eruatur mihi alter oculus." This story was always a very popular one, as may be seen by a glance at the long list of parallels cited by Oesterley to Pauli, 647. Another story in Peraldus ii, 307, "true son refusing to shoot arrow at father's dead body," may likewise be compared with Etienne de Bourbon, No. 160 (mentioned above), Bromyard, F. 5, 17, *Prompt. Ex.*, B. 9, and *Libro de Enxemplos*, 103 (see also *Gesta Rom.* ed. Oesterly, cap. 45).

‡ Peraldus, too, reproves trains and long shoes. ii, 211, 212, 215.

§ This work, although popular, has not passed through as many editions as some of the above mentioned work. The following are all the editions we can discover: *editio princ.* s. l. e. a. fol.; Norinberg., 1485, 4to. (Fabricius, fol.); *ibid.*, 1518, 4to.; Parisiis, 1518, 4to.; Lugd., 15, 22, 4to; Venet, 1586, fol. (Fabr. 4to); Antverp, 1614, fol. Our copy is the last named.

leaving, besides his *Summa* and some writings against Wicliff, a work entitled: *Opus trivium sive tractatus juris civilis et canonici ad moralem sensum applicati secundum ordinem alphabeti.** Some idea of the extent of the *Summa* may be gained from the fact that the edition of 1614 consists of two parts containing nine hundred and seventy-one folio pages, exclusive of the indices. The arrangement is the usual one of topics alphabetically disposed: nineteen letters (or twenty-one, distinguishing i and u) embracing one hundred and eighty-nine topics treated in as many chapters. The range of subjects may be shown by the titles under some of the letters taken at random. We give all the divisions of the letters chosen, naturally, however, selecting those which contain fewest chapters: *Beatudo, bellum, benefacere, bonitas; gaudium, gloria, gratia, gratitudo, gula; labor, laus, lex, liber, loquatio, ludus, luxuria; nativitas, negligentia, nobilitas, nocumentum; tentatio, testimonium, timor, trinitas, tribulatio,* etc. Each chapter is preceded by a *summarium* of the sections into which it is divided, and these sections are still further divided into paragraphs or articles. The *exempla* are usually, but not always, indicated by the word *exemplum* or its abbreviation in the margin. The stories themselves are, as in Peraldus, generally given in brief and dry versions. These illustrative *exempla*, which, for us, constitute the chief value of the work, are very numerous. Goedeke (*Orient und Occident*, i, 538) says their number is over a thousand, and remarks: "Kaum irgend ein anderes Werk des Mittelalters ist so reich an Fabeln und Geschichten als das seinige (the *Summa*), und kaum ein anderes von dieser Bedeutung so wenig bekannt. Wright (Latin Stories, Percy Soc., Vol. viii, p. viii) says: "Perhaps no work is more worthy the attention of those who are interested in the popular literature and history of England in the fourteenth century."† Bromyard seldom names his sources, but as Goedeke (*op. cit.*, p. 538) says: "Ueberall darf Entlehnung vorausgesetzt werden." These sources are the whole body of mediæval and classical literature then known to the learned. Scarcely any department of these two great divisions is unrepresented: fables, legends, mediæval epics, Oriental apologues, anecdotes from Roman history, from Biblical history, popular jests, etc., are mingled with a mass of references to contemporary manners and customs which render the work invaluable to the student of mediæval culture. It is impossible in our limited space to give even a brief selection from Bromyard's stories. Those cited by Wright will give those who do not have access to the original a fair idea of its contents, and a glance through Oesterley's references to Pauli, Kirchhof, and the *Gesta Romanorum*, will show that Bromyard has absorbed into his vast encyclopedia most of the popular stories of his day.‡

Before leaving the class of treatises, there is one work which may be

* Fabricius, *ed. cit.*, i, p. 263; Græsse, ii, 2, 1, pp, 166, 380.

† Of the one hundred and forty-nine stories given by Wright, over fifty are taken from Bromyard, and eleven from the *Promptuarium Exemplorum*.

‡ About one hundred and fifty of Bromyard's stories are found in these collections.

mentioned here, although, strictly speaking, it is not a treatise in the same sense as the works already described. We refer to Robert Holcot's *Opus super Sapientiam Solomonis.** The author was, like Bromyard, an English Dominican, born at Northampton, and professor of theology at Oxford, where he died in 1349, leaving a large number of commentaries on various books of the Bible, the best known being, the one on the Wisdom of Solomon.† This work consists of two hundred and twelve *lectiones* on the nineteen chapters of the wisdom with the usual extensive index. *Exempla* properly so-called are very sparingly used by the author, one of them (Pauli, 647), has already been given above, and one of La Fontaine's most celebrated fables (Bk. vi, 4, "Jupiter et le Métayer") is found in *Lectio* IX. On the other hand, the work is a vast repertory of historical anecdotes embedded in the most elaborate metaphors. A good example of Holkot's method may be found in the *Lectio* LXIV, where he discusses Chap. V, v. 9–10 of his text, "All those things are passed away like a shadow, and as a post that hasteth by; And as a ship that passeth over the waves of the water, which, when it is gone by, the trace thereof cannot be found, neither the pathway of the keel in the waves." As there are three kinds of sin: original, venial, and mortal, so there are three kinds of shadows corresponding in shape to the cylinder, cone, and inverted cone (*chilindroydes, conoydes,* and *calathoydes*). In speaking of the simile of the ship, Holkot quotes from St. Jerome's *epistolae*, cxv, the story of Xerxes weeping because none of those he beheld at a review of his army would be alive in a hundred years. He then compares penitence to a ship on account of its figure, capacity for carrying, and possibility of wreck. This affords Holkot an opportunity, after citing Job, Boethius, and Gregory, to describe the Sirens and Ulysses's adventure with them. His sources are, as he states: *Alexander in scintillario poesis,*‡ and Boethius, *de Consolat*, iii. 3. In his third lecture he

*See Hain, Nos. 8755–61. The first edition is of Cologne, no date, our copy is the third edition (Hain, No. 8757); Spires, 1483, Petrus Drach. For other editions, see Grœsse, *op. cit.* ii, 2, 1, p. 470.

†Holcot left another work which would also come within the scope of this article, but which we have not been able to procure. It is the *Moralitates pulchrae historiarum in usum praedicatorum*, Venet. 1505; Paris, 1510, and with the *Liber Sap.*, 1580. This work varies somewhat in the different editions, but the original form seems to have consisted of forty-seven stories, afterwards amplified to seventy-five. This collection is of great importance for the question of the mode in which the *Gesta Romanorum* was put together, and Oesterley in his edition of that work, after an analysis of the *Moralitates*, says, p. 251: "Die Wichtigkeit dieses Werkes braucht nicht besonders hervorgehoben zu werden, es ist in ihm nicht allein die Quelle vieler Nummern des Gesta Romanorum nachgewiesen, die bisher unbekannt geblieben war, sondern dasselbe hat auf die Gestaltung unserer Sammlung einen so entscheidenden Einfluss ausgeübt, dass man die sämmtlichen Handschriften in zwei Classen theilen könnte, deren eine von Holkot beeinflusst ist, deren andere aber einen solchen Einfluss nicht zeigt, und es ist das ein nicht unwichtiges Moment für die Entscheidung der Frage über das Alter der Gesta Romanorum."

‡This is Alexander Neckam, see Leyser, *Hist. Poetarum et Poematum Medii Aevi*, Halle, 1721, p. 993.

mentions Alexander and the pirate (*Gesta Rom.* 146); in the ninth occurs the fable of La Fontaine vi, 4, mentioned above; in the fourteenth, the story of Atalanta (*Gesta Rom.* 60), cited from Ovid; in the forty-fifth, the story of the two snakes (*Gesta Rom.* 92), cited from Valerius Maximus (4. 6, 1); in the seventieth, Damocles's sword cited from Macrobius, *Somn. Scip.* 1, 10 (*Gesta Rom.* 143); in the eighty-second, the poisoned wine from Frontinus, *Strateg.* 2. 5, 12 (*Gesta Rom.* 88); in the eighty-sixth "judge flayed," from Helinand, lib. xv. (*Gesta Rom.* 29); in the one hundred and thirteenth, "the ring of forgetfulness and memory," from "*magister in historiis super Exodus*," the story is told of Moses (*Gesta Rom.* 10, of the Emperor Vespasian); in the hundred and forty-first, the story of Phalaris and his brazen bull from Ovid (*Gesta Rom.* 48); in the one hundred and seventy-fifth, Coriolanus, Valerius Maximus 5, 4, 1 (*Gesta Rom.* 137); in the one hundred and eighty-eighth, La Fontaine, vii, 1, *Les Animaux malades de la peste;* in the hundred and ninetieth, the legend of Silvester II (Gerbert), v, Milman Latin Christ, iii, p. 220; *ibid*, wax image of husband shot at by wife's lover (*Gesta Rom.* 102). We have mentioned only a few of the stories most popular during the middle ages, and our citations can give but a feeble idea of the mass of historical and mythological references to be found in Holkot.

It remains finally to notice very briefly the class of sermons from which we have selected two of the most popular collections as examples.* The first is the sermons of Herolt who has already been considered as the author of the *Promptuarium Exemplorum*. The popularity of his collection was shown by the large number of editions through which it passed, and all we have now to do is to examine the form and contents of the work itself.† The sermons, as is usual, are divided into those for the ordinary Sundays of the year, *de tempore*, and those for saints' days, *de sanctis*; of the former there are one hundred and sixty-four, of the latter forty-eight. From one to five sermons are devoted to a single Sunday or saint, and reference is sometimes made to other sermons in the same collection which may likewise be used. Where several sermons are given for one occasion, they are considered as one, and the method of division is continuous. This consists in a rude paragraphing by means of capital letters. Not only is reference facilitated by an alphabetical index, but an additional index is given of the *exempla* in the *sermones de tempore* and a briefer index of the *sermones de sanctis*. As to the organic division of the sermons, the

* For the vast mass of inedited material, see L. de la Marche, *La Chaire française*, etc., *table bibliographique*, pp. 457–499; for printed sermons, Græsse, *op. cit.* ii, 2, 1, pp. 152–175; for collections of sermons designed especially for the use of preachers, Cruel, *op. cit.* pp. 468–493; for general *résumé* (XIV century), *Hist. litt. de la France*, xxiv, pp. 363–382.

† Cruel, p. 480, says: "The most used work of this class (the sermons for the use of preachers) are the *Sermones Discipuli*, which passed through thirty-six editions before 1500. How well known this work was is shown from a passage in Geiler's Postils to the eighth Sunday after Trinity, where the author after the division of his subject into heads, says: Now mark! you will find these things neither in Jacobo de Voragine nor in Discipulo."

author in the prologue to the *serm. de sanctis*, says: "Dividendo eundem sermonem in tres partes. Pria pars erit de dignitate et privilegiis istius sancti vel istorum sanctorum et sanctarum. Secunda pars principalis erit pro informatione hominum simplicium et specialiter ad emendationem suae vitae. Tercia pars erit de miraculis istius sancti aut illorum sanctorum vel sanctarum." The division of the *sermo de tempore* is also usually threefold, the *exemplum* coming last. The following brief analysis of one of Herolt's sermons may not be unacceptable. *Sermo xvi, De innocentibus.* "Mittens Herodes occidit omnes pueros qui erant in Bethleem et in omnibus finibus ejus, Matt. ii. Ex quo hodie peragitur festum illorum puerorum innocentium qui ab iniquo Herode interfecti sint, tunc in presenti sermone tria sunt dicenda. Primo quod aliqui parentes suos pueros spiritualiter occidunt sicut Herodes corporaliter occidet. Secundo de solemnitate presentis festi. Tercio exemplum." "There are six classes of parents who kill their children: those who kill the child yet unborn, those who love their children too much ("Qui amat filium vel filiam super me non est me dignus," Matt. x), those who teach them evil, as dancing, wearing their rich clothes, painting their faces and curling their hair, those who do not punish their children when they err, those who set their children a bad example, and thus kill them spiritually, and finally those who amass wealth unjustly in order to enrich their offspring. Secondly, the feast of the Innocents is to be observed solemnly for three reasons: first, on account of the time, they were the first martyrs, secondly, on account of their number, thirdly, on account of the place. Thirdly, mark an example of those who do not correct their children when they err. We read of a certain father who was accustomed to visit taverns and games, and take his little son with him. When the son grew up he was so used to taverns and games that he could not be kept away from them, and after he had spent his own money, he began to steal, first from his father, then from his neighbors. His father did not punish him severely, but gently reproved him. This admonition, however, had no effect, and when he grew to be a man, he was caught once and again in theft, but twice was saved from the gallows by a fine. The third time he was detected he was sentenced to death, and led to the gibbet. There he begged that his father might be brought to him. He came weeping, and the son asked him to kiss him, and forgive him the wrong he had done him. When the father did as he was asked, his son bit off his nose. The son was censured because twice his father had saved him from death by paying a fine, and would gladly have freed him a third time had he been able. The son, however, answered: 'I have acted well and justly because he is the cause of my death, for from my youth up he permitted me to live according to my own will, neither corrected me at any time for the excesses I committed.'"* At the end of the lxxxiv, sermon *de tempore* (*De gaudiis coeli*) occurs the following beautiful and well-known *exemplum* which Mr. Longfellow's readers will recognize as the story of Monk Felix in the Golden Legend.

* For parallels see Pauli, 19. This story occurs in Etienne de Bourbon, and has been already mentioned.

"Likewise we read this example of the joys of Heaven. A certain devout monk prayed God to reveal to him some of the sweetness of the heavenly joys. One day while at prayer he heard a little bird singing sweetly near by. Arising from his prayers he wished to catch the bird which flew away before him to a wood near the monastery, and alighted on a tree. The monk followed it and stood under the tree listening to the bird which presently flew away, and the monk returned to the monastery thinking he had stood beneath the tree an hour or two. When he reached the monastery he found the door had been built up, and another opened in a different part of the monastery. He approached and knocked, and the porter asked whence he came, who he was, and what he wanted. He replied: I left the monastery a little while ago, and now I have returned, and it has been changed. The porter went in and told the abbot, who came to the door and asked the monk who he was and whence he came. He responded: I am a brother of this monastery, and I went a short time ago to the wood, and returned, and I know no one, and no one knows me. Then the abbot and the seniors asked him the name of the abbot who ruled the monastery when he went out, and searching the chronicles they found he had been absent from the monastery three hundred and forty years. It was a great thing that in all that time on account of the sweet song of that bird or angel, he had felt neither cold nor heat, neither had hungered nor thirsted. What then shall it be when we enter heaven and hear the nine choirs of angels singing?"* In concluding this very inadequate account of Herolt's collection, we cannot do better than cite a few words from Cruel's appreciation (p. 481): "The work was very copious, and exerted from the large number of its *exempla*, a peculiar attraction. What, however, above all, made it popular and distinguished it from earlier collections was the practical direction of its contents, whereby the author held himself free from all doctrinary generalities, and kept in sight the concrete truth in order to bring before the bar the prevailing faults and vices of his day, and to examine from an ecclesiastical standpoint the most various relations of civil life. The editors of the earliest edition (1476) had this especially in view, when they remarked in their concluding words: 'Huic (autori) applaudi, hunc efferri laudibus, hunc praedicatum iri miretur nemo, cum certissime constet, inter modernos sermonistas eum in vulgi scientia tenere principatum.' In order to become acquainted with this practical popular side one needs only to glance over a list of the subjects he treated. Superiors and dependents, masters and servants, manufac-

*See Von der Hagen's *Gesammtabent*, xc: *Magnum Spec. Exemp., Coelestis gloria, Exemp. xiv*; cp. Ralston's Russian Folk Tales, p. 310; Cox, Aryan. Myth. i, 413; Baring Gould's Curious Myths, 1872, pp. 92, 112. The following are some of the most popular *exempla* in the sermons; as this work must be rare in this country, we mention where corresponding stories may be found in more accessible collections: *Gesta Rom.* 80, 125, 143, 171, 215, 249; Pauli, 19, 84, 222, 388, 398, 462; Kirchhof 1, 366; 1, 2, 50; La Fontaine vi, 4; Etienne de Bourbon, 43, 258, 298. In the xxi *Sermo de sanctis* may be found an interesting version of the legends of the wood of the cross, see Meyer, *op. cit.* p. 28.

turers and workmen, nobility, merchants, Jews, usurers, dancing, oaths, blasphemy and profanity, jesting and play, falsehood, sinful apparel, superstitions, duties of parents to children, and *vice versa*, how one can sin in eating, etc."

The last collection we shall mention is that of Oswald Pelbart, usually called Pelbartus de Themeswar, a Franciscan monk from Themeswar in Hungary, who flourished in the latter part of the fifteenth century, and was widely known by his sermons. The collection bears the fantastic title of *Pomerium* (orchard), and consists of *sermones de tempore, de sanctis*, and *quadragesimales*.* Another work by the same author is usually bound up with one of the above collections. It bears the somewhat misleading title: *Pomerium sermonum de beata virgine dei genetrice vel Stellarium corone beate virginis pro singularum festivitatum eiusdem predicationibus coaptatum*. It is not, as might seem, a collection of sermons, but a treatise in twelve books for the use of preachers, and might perhaps more properly have been mentioned above. The last part of the twelfth book is devoted to the miracles of the Virgin. The *sermones de sanctis* number in all two hundred and twenty-one; ninety-seven in the *pars hyemalis*, and one hundred and twenty-four in the *pars estivalis*. As in Herolt, so here several sermons are devoted to the same feast, the first of the series containing the legend at the end of the sermon. The sermons are paragraphed in the usual way, and there are copious indices. The work no longer has an anecdotal character, a strict analytical method is pursued, and the writer generally confines his citations to the Scriptures, and the doctors of the Church.

We shall take leave of the last class of our subject with a brief reference to some sermons in the vulgar tongue containing *exempla*. They are the sermons of St. Bernardino of Siena, who died in 1444, and was canonized six years later. Thus far only ten of the forty-five Italian sermons of St. Bernardino have been edited (Siena, 1853), the *exempla*, however, to the number of thirty-eight have been extracted, and published by Francesco Zambrini, under the title: *Novellette, esempi morali e apologhi di San Bernardino da Siena*, Bologna, 1868 (*Scelta di curiosità letterarie inedite o rare dal secolo xiii al xvii, Dispensa xcvii*). Many of these *exempla* are contemporaneous anecdotes, here and there are found fables or stories forming part of the common stock of Europe. Among the fables are: iii, La Fontaine iii, 1; vi, *ibid.* xi, 6; ix. Voigt, *Kleinere latein. Denkmäler der Thiersage*, Strassburg, 1878, pp. 81, 138; *xvii*, "*Di una scimia la quale per vendetta arse uno orso*;" *xxv*, "*Dell' asino delle tre ville*," for the last two we have found no parallels. Among the stories are: xiv (Etienne de Bourbon, 456); viii (*ibid.* 385); xxix (*ibid.* 483, Pauli, 372).†

* For editions see Hain, Nos. 12548-66; Græsse ii, 2, 1, p. 420; Fabricius, *ed. cit*, v. 213. We have been able to procure the *sermones de sanctis* only in the edition of Hagenau, 1511, fol. containing also the *Stellarium coronae B. V.* mentioned above.

† While this article was in preparation, our eye fell on the following advertisement, which again proves that there is nothing new under the sun: "—— & Co.

We have performed our task in a very bungling manner if we have not enabled the reader to form some idea of the wealth of material buried in these long unused volumes, material of great value for the historian of manners and customs, and for one engaged in tracing the affiliation of the popular tales of Europe. As it is in the latter direction that our own interest chiefly lies, we may be pardoned for concluding this already lengthy article with some reference to the light thrown upon the diffusion of popular tales by the collections just examined. In these we find every class of popular tales except fairy stories—legends, jests, fables, etc. The extensive currency given to these stories by their reception into these collections can hardly be imagined. They were used by numberless preachers in their sermons to the people, and by them in turn repeated to others. We must bear in mind that down to the Reformation Europe constituted a homogeneous whole, and that there existed a *Weltliteratur* in Goethe's sense of the word. A legend or story that appealed to the imagination or taste had free circulation from Iceland to Sicily, and from Italy to Portugal. One or two examples will perhaps best illustrate the part played by the sermon-books in this diffusion. We have already mentioned La Fontaine's fable (vii, 10), *La Laitière et le pot au lait*, and have shown that before the version in the *Dialogus Creaturarum*, the fable was widely diffused by Jacques de Vitry and Etienne de Bourbon. A still more striking instance of another Oriental apologue introduced into Europe by the same channel is the fable which Gœdeke entitles *Asinus vulgi* (La Font. iii, 1 *Le Meunier, son Fils et l'Ane*), first found in an Occidental version in Jacques de Vitry, and copied from him by Etienne de Bourbon.* The former of the two stories just mentioned has become popular in the technical sense, and is found in Grimm's *Kinder-und Hausmärchen*, No. 164, *Der faule Heinz*, but in a version pointing to the Oriental original in the Pantschatantra and Hitopadesa. It would, however, not be difficult to find stories still existing among the people, and which were originally communicated to them by the sermon-books. An interesting instance of this is the story found in Grimm No. 145. The ungrateful son (*Der Undankbare Sohn*), which is so short that we may give it in full: "Once upon a time a man and his wife were sitting before their house-door, with a roast fowl on a table between them, which they were going to eat together. Presently the man saw his old father coming, and he quickly snatched up the fowl and concealed it, because he grudged sharing it, even with his own parent. The old man came, had a draught of water, and then went away again. As soon as he was gone, his son went to fetch the roast fowl again; but

will begin publication immediately of 'The Clerical Library,' or helps to sermonizing as the series might be called. Three of the proposed twelve volumes, each of which will be complete, are entitled, 'Three Hundred Outlines of Sermons on the N. T.,' and again on the O. T., and 'Outline Sermons to Children with Numerous Anecdotes.'"

*See Gœdeke's article already mentioned in *Orient und Occident*, 1, pp. 531, 733: Pauli, 577, to the references given in these articles may be added, San Bernardino, *Novellette*, p. 5.

when he touched it he saw that it was changed into a toad, which sprang upon his face and squatted there, and would not go away. When any one tried to take it off, it spat out poison and seemed about to spring in the face, so that at length nobody dared to meddle with it. Now this toad the ungrateful son was compelled to feed, lest it should feed on his flesh; and with this companion he moved wearily about from place to place, and had no rest anywhere in this world." This very story is found in Etienne de Bourbon, 163, Bromyard, F. 22, Pelbartus, *Serm. de Temp. Hiem.*, 22, B, not to mention other works of the same class, which are mentioned in Oesterley's notes to Pauli, 437, and in Douhet, *Dictionnaire des Légendes*, col. 305, n. 158. Until quite recently Grimm's version was the only popular one known, but a version from Lower Brittany has lately been published by F. M. Luzel, *Légendes chrétiennes de la Basse-Bretagne*, Paris, 1881, vol. ii, p. 179, *Le Fils ingrat*. There are probably other popular versions which have not yet been collected, the class of legends or legendary and religious stories having been greatly neglected by collectors of popular literature. There is no need of insisting upon the importance of the *exempla* in the diffusion of stories, but we may mention in conclusion two cases of wholesale absorption of Oriental stories into collections of *exempla* or similar works. The first case is that of the *Disciplina clericalis* of Petrus Alfonsi, which has been taken up into the *Libro de Enxemplos* mentioned above; the second is the Seven Wise Masters, a compend of which is found in the *Scala Coeli* of a Dominican monk, Joannes Junior, who lived in the middle of the XIV century, and wrote a work of the same general description as Bromyard's and Etienne de Bourbon's.* Separate stories from both of the above Oriental collections are frequently encountered among the popular tales of Europe, and their wide diffusion is doubtless due to their absorption into the above collections.

The Latitude of Haverford College Observatory. By Isaac Sharpless.

(*Read before the American Philosophical Society, April 6, 1883.*)

The latitude of Harverford College Observatory was determined in the year 1854, by Prof. Jos. G. Harlan, by the use of a transit instrument in the prime vertical. Imperfect records of his results and none at all of his computations remain, but from them he deduced a value of 40° 0′ 36.5″.

In the spring of 1881, a zenith instrument was placed in position in the observatory. The telescope has an aperture of $1\frac{3}{4}$ inches, and with its standards revolves about a vertical axis. It is provided with micrometer and levels.

* This compend of Joannes Junior is of great importance in the study of the Western branch of the Seven Wise Masters, and has been reprinted by K. Goedeke in the *Orient und Occident*, iii, pp. 388-423, *Liber de septem Sapientibus*.

The latitude was determined by pairs of stars, one of each pair being north and one south of the zenith. The difference of the zenith distances was measured by the micrometer and the latitude calculated by the formula,

$$\varphi = \tfrac{1}{2}(\delta + \delta') + \tfrac{1}{2}(Z - Z')$$

As a preliminary work the value of a revolution of the microméter screw was determined by observing the passage of a star between the wires set at some known distance apart, and multiplying the time by the factor $\frac{15 \times \cos \text{Dec}}{\text{Dist. between wires}}$. The mean of twenty-one observations was 111.6″.

A better result was obtained by the method of observing Polaris at time of greatest elongation. This time T_0 and the zenith distance Z_0 were first calculated and the telescope set at the latter angle. About twenty minutes before T_0 the movable micrometer wire was set in front of the star and the time of crossing recorded on the chronograph; the wire was then advanced one-fifth of a revolution, and the time again noted, and so on forty times. From these were obtained twenty values of a revolution of the screw. The computation is given in outline in the following table. The quantity $Z - Z_0$ was computed in each case by the equation :

$$Z - Z_0 = \sin (T - T_0) \frac{\cos \delta}{\sin 1''}$$

The level error was so slight that it was not taken into account ;

No.	Micrometer Reading.	T.		$T - T_0$.		$Z - Z_0$.
1	6.80	$6^h\ 50^m$	18.^{s}2	—	21^m 3.^{s}1	— 433.59
2	6.60	51	16.2	—	20 5.1	— 412.68
3	6.40	52	33.2	—	18 49.1	— 387.70
4	6.20	53	34.2	—	17 47.1	— 366.55
5	6.	54	40.9	—	16 40.4	— 343.59
	etc.	etc.			etc.	etc.
21	2.80	6^h 72	0.2	+	0 38.9	+ 13.55
22	2.60	73	16.4	+	1 45.1	+ 36.12
23	2.40	74	17.4	+	2 56.1	+ 60.52
24	2.20	75	4.2	+	3 42.9	+ 76.61
25	2.	76	14.4	+	4 53.1	+ 100.74
	etc.	etc.			etc.	etc.

Comparing the 1st observation with 21st, the 2d with 22d and so on, and dividing the results by 4, we obtain for the value of a revolution of the screw by this method the following :

111.78	111.25	113.04	109.92
112.20	110.71	113.98	112.66
112.05	111.28	113.26	112.76
110.76	110.67	112.78	111.88
111.08	111.59	112.25	111.16

The mean of these is 111.″9 and this is the value employed in subse-

quent work. The probable error of this mean by the method of least square is 0.″14.

The value of a level division was obtained by placing the movable micrometer wire on a terrestrial mark, and taking the reading, and again after the instrument was changed in altitude so as to cause the bubble to to move through a certain number of divisions. This gave it in micrometer revolutions, which were afterwards reduced to seconds. The result of a large number of determinations gave, as the most probable value, 6″.3.

The stars used were taken from the Nine Years Catalogue of Greenwich Observatory for 1872, the mean declinations calculated for the epoch 1881.0, 1882.0, or 1883.0, and the apparent declinations for the night of observation were obtained by the use of the "independent star numbers" of the American Nautical Almanac. The results were as follows:

Date.	Catalogue No. of Stars.		½ (δ + δ′)	Micrometer Correction.	Level Correction.	Latitude.
1881.						
10 mo. 26.	62	77	40° 5′ 32″.99	— 4′ 45″.85	— 6″.72	40° 0′ 40″.42
"	2166	2185	40 0 56.29	— 16.45	+ 8.	42.84
"	48	51	39 56 22.	+ 4 6.23	+ 10.5	38.73
10 mo. 27.	48	51	39 56 22.	+ 4 25.65	— 8.1	39.55
11 mo. 15.	2166	2185				42.92
"	48	51	39 56 24.45	+ 4 19.83	— 4.5	40.08
12 mo. 8.	48	51	39 56 26.23	+ 3 57.26	+ 17.85	41.34
12 mo. 9.	48	51	39 56 26.29	+ 3 57.57	+ 20.1	43.89
12 mo. 10.	48	51	39 56 26.30	+ 4 1.59	+ 14.6	42.49
"	62	77	40 5 41.87	— 5 13.27	+ 14.6	43.20
12 mo. 16.	48	14	39 56 26.39	+ 4 30.50	— 11.85	45.11
"	62	77	40 5 38.40	— 4 43.65	— 14.7	40.05
12 mo. 17.	62	77	40 5 38.46	— 4 50.65	— 7.7	40.11
12 mo. 19.	48	51	39 56 26.54	+ 4 24.07	— 12.3	38.31
"	62	77	40 5 38.48	— 4 50.16	— 9.9	38.42
12 mo. 24.	48	51	39 56 26.80	+ 4 16.86	— 2.4	41.26
"	62	77	40 5 38.43	— 4 51.5	— 8.55	38.28
1882.						
1 mo. 27.	567	569	40 6 16.17	— 5 42.02	+ 5.78	39.93
1 mo. 30.	530	550	39 59 51.73	+ 42.69	+ 3.	37.42
"	567	569	40 6 24.03	— 5 39.50	+ 6.13	38.40
2 mo. 1.	530	550	39 59 51.44	+ 41.24	+ 6.45	39.13
"	567	569	40 6 15.67	— 5 43.53	+ 3.80	35.94
2 mo. 8.	530	550	39 59 58.19	+ 32.12	+ 12.6	42 91
2 mo. 10.	530	550	39 59 58.27	+ 30.21	+ 9.88	38.36
"	567	569	40 6 22.28	— 5 46.38	+ 3.3	39.20
2 mo. 11.	530	550	39 59 58.31	+ 37.88	+ 8.85	45.04
2 mo. 14.	567	569	40 6 22.00	— 5 48.34	+ 2.55	36.21
2 mo. 17.	530	550	39 59 58.60	+ 28.98	+ 8.85	36.43
11 mo. 5.	2049	2070	40 0 59.76	+ 6.32	— 22.05	44.03
11 mo. 9.	2049	2070	40 0 59.645	+ 1.119	— 20.217	40.55
12 mo. 8.	2166	2185	40 1 15.573	— 41.347	+ 2.0475	36.27
12 mo. 11.	62	77	40 5 57.32	— 5 30.944	+ 11.025	37.40
12 mo. 16.	48	51	39 56 44.92	+ 4 24.307	— 31.5	37.73
12 mo. 18.	48	51	39 56 44.923	+ 3 36.582	+ 17.797	39.30
12 mo. 18.	62	77	40 5 57.46	— 5 36.966	+ 18.27	38.77
12 mo. 19.	48	51	39 56 44.92	+ 3 37.5338	+ 18.1115	39.97
12 mo. 28.	48	51	39 56 44.79	+ 4 5.7883	— 13.86	36.72
12 mo. 28.	62	77	40 5 56.813	— 5 2.13	— 17.64	37.04
1883.						
1 mo. 2.	261	279	39 54 46.794	+ 6 5.913	— 15.281	37.44
1 mo. 11.	261	279	39 54 51.519	+ 6 10.366	— 21.735	40.15
1 mo. 12.	530	550	39 59 58.852	+ 54.495	— 7.087	41.26
1 mo. 22.	530	550	39 59 56.380	+ 50.243	— 5.985	40.64
2 mo. 2.	530	550	39 59 52.351	+ 1 6.02	— 20.947	38.37
2 mo. 5.	466	475	40 10 41.431	— 10 19.478	+ 15.12	37.07

Date.	Catalogue No. of Stars.		½ (δ + δ').			Micrometer Correction.		Level Correction.	Latitude.
1883.									
2 mo. 5.	489	495	39	58	56.523	+ 1	12.567	+ 31.815	39·91
"	530	550	39	59	56.002	+	24.5061	+ 22.68	43.19
"	567	569	40	6	19.803	— 6	5.969	+ 23.153	36.99
2 mo. 8.	466	475	40	10	44.976	— 10	11.925	+ 3.78	36.83
"	467	475	40	12	12.959	— 11	37.301	+ 3.78	39.44
"	489	495	39	58	55.198	+ 1	41.325	+ 3.15	39.67
"	530	550	39	50	56.306	+	43 75	+ 0.787	40.84
"	567	569	40	6	20.131	— 5	43.5889	+ 3.15	39.70
"	577	591	39	51	35.175	+ 9	9.149	— 3.44	40.88
"	578	591	40	5	10.217	— 4	27.16	+ 3.44	39.62
2 mo. 9.	466	475	40	10	44.976	— 9	9.373	+ 7.56	43.16
"	489	495	39	58	55.198	+ 1	40.150	+ 3.44	38.79
"	567	569	40	6	20.1325	— 5	45.9948	+ 7.245	41.38
"	682	710	39	56	19.1645	+ 4	13.733	+ 6.3	39.20
"	697	710	39	54	34.2665	+ 6	1.493	+ 6.3	42.46
2 mo. 12.	466	475	40	10	44.041	— 9	46.635	+ 7.56	41.97
"	489	495	39	58.	55.782	+ 1	33.044	+ 6.615	35.43
"	530	550	39	59	56.5065	+	41 1792	+ 3.15	40.84
"	567	569	40	6	20.3575	— 5	43.309	+ 2.3625	39.41
"	578	591	40	5	4.822	— 4	20.769	+ 2.677	37.73
"	697	710	39	54	34.5405	+ 6	10.165	+ .945	45.65
2 mo. 13.	466	475	40	10	44.041	— 10	13.547	+ 6.15	37.11
"	567	569	40	6	20.3575	— 5	34.0215	— 9.135	37.20
"	697	710	39	54	34.5405	+ 6	22.1385	— 14.49	42.18
2 mo. 23.	530	550	39	59	57.113	+	44.928	+ .787	42 83
"	753	757	39	56	7.521	+ 4	37.368	— 4.882	40.01
2 mo. 27.	530	550	39	59	57.031	+	44.20	+ 3.1	44.33
3 mo. 8.	812	822	39	54	18.609	+ 6	28.125	— 2.047	44.69
3 mo. 13.	779	812	40	0	26.399	+	3.357	+ 11.496	41.27
"	779	834	39	53	53.759	+ 6	35.276	+ 11.025	40.06
"	779	859	39	56	43.715	+ 3	47.381	+ 7.718	38.81
3 mo. 14.	812	822	39	54	19.105	+ 6	24.098		43.20

The mean of these 76 results gives the latitude of the Observatory

40° 0′ 40.085.

Assuming them all to be of equal weight, the probable error of a single observation is 1.706″ and of the final result .191″.

NOTE.—The value of the longitude of the Observatory, standing on our books, but obtained, we do not know how, is 6m. 59.3 sec. East of Washington. At the time of the Transit of Venus, Washington time was telegraphed to our railroad station, distant one-half mile from the Observatory and compared with our local time. The mean of three days' comparisons gave a difference of 6m. 59.6 sec.

On a Crinoid with Movable Spines. *By Henry S. Williams.*

(*Read before the American Philosophical Society, April 20, 1883.*)

Among the rarer forms of the second fauna of the upper Devonian, at the base of the Chemung group, Ithaca, N. Y., is a Crinoid with some interesting features.

In its general characters it agrees with the family *Platycrinidæ* of Rœmer, and falls under the section *Hexacrinites* as defined by Wachsmuth and Springer in Revision of the Palæocrinoidea, Pt. II, p. 56.

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It differs from the genus *Hexacrinus* Austin, as generally understood, in possessing a well defined third primary radial similar in size to the second, and from which the free arms abruptly diverge.

In respect of one character it differs fundamentally from all the known representations of the genus, section or family; and, in fact, from all hitherto described Crinoids, in the possession of slender, acicular spines which were free from the plates, and were evidently articulated by some means upon elevated pitted tubercles on the surface of the plates of the calyx, vault and free arms.

We find so-called spines on a few Crinoids, on the plates of the vault in the genera Dorycrinus and Amphoracocrinus, and upon the calyx plates of Rhodocrinus and other genera.

In all these cases, however, the "spines" or tubercles consist merely of thorn-like expansions of the plates, and, so far as I can learn, there is no recorded evidence of the occurrence upon any true Crinoid, of free spines articulated to the plates as in the Echinoids.

In the absence of the spines themselves, the low rounded tubercles, pitted at the apex, suggest resemblance to the mamelon of the Echinoids, but in the specimens herein described, the spines as well as the tubercles are represented.

Other specimens have been examined in which the pitted tubercles alone are seen; the spines have been found in only a single locality, but there upon several individuals.

These specimens, like most of the fossils of the fine sandy shales of the upper Devonian, are in the condition of hollow impressions preserving scarcely a particle of the original substance of the test, but the impressions are beautifully perfect, showing the finest details of surface marking and configuration. On the impressions of some of the slender spines, fine longitudinal striæ, invisible to the naked eye, are distinctly seen with a good lens.

Palæontologists accustomed to throw aside these hollow impressions of fossils in the Chemung rocks, as poor and worthless specimens, will be surprised at the perfection in which all the surface details, external and internal are preserved.

Many minute characters are visible in such specimens that are rarely seen in so called perfect specimens from limestone rocks, where the immediate surface is very generally removed in taking the fossil from the matrix.

In the present case the specimens break along the cavities from which the test has been dissolved, the inner and outer surfaces of the plates both appearing, and the spines in place. That they were true spines, and not prolongations of the plate surface is evidenced by the fact that the spines, though in place, like bristles radiating from the surface, are in no case entirely continuous with the impressions left by the removal of the plate; there is always a thin film of matrix separating the base of the spine from the apex of the tubercles, to which in several cases they are closely approximate.

When the spines are preserved in relation to the vault, although the specimen was crushed and thrown out of normal shape, the vault plates and their spines were held together during the process of fossilization.

The evidence is such as to suggest that the spines were united to the plates by a tough ligamentous attachment which withstood decomposition long after the fossil was buried.

The calyx plates were thin and frequently occur detached, but the basal plates were thickened toward the center of the disk where they joined the column, and were generally preserved together, though separate from the rest of the calyx.

In studying this genus, I have examined several specimens which agree with the typical form in the general character of the plates and the arms in one case, and possess the pitted tubercles on the surface.

The most important among these is the original specimen of a figure issued by the New York State Museum with the name *Platycrinus? punctobrachiatus.*

The original is in the Museum of Cornell University. The name was proposed by Prof. Hall, but, as he informs me, the species was never described. This, with several other undescribed species, was photographed and the plate was privately distributed abut 1872, with names attached, but with no descriptions. The arms, the shape of calyx, and the plates that were preserved, correspond in general with the *A. Ithacensis*, but the tubercles on the calyx plates are finer, more numerous, and the pitting very indistinct, and the basal plates are relatively larger than in the typical specimens of that species. Hence we are led to believe that the Hamilton species is distinct from the Chemung specimens, and even if it were properly described and published, it is probably safe to regard it as a distinct species. Although the specimen shows no traces of the free spines, the nature of the tubercles leave little doubt of a generic identity with *Arthroacantha Ithacensis*, and the Hamilton form may be called *Arthroacantha punctobrachiata.*

In the Museum of Cornell University are two specimens, each a portion of the basal disc, which appear to be identical with *A. punctobrachiatus.*

One is marked *Moscow shale*, locality not designated; the other is marked *Hamilton Period, Delphi, N. Y.*, and is on a soft dark shale with specimens of *Pholidops.*

Another specimen, generically identical, but too imperfect for specific determination, is in the collection of Prof. S. G. Williams, from the Hamilton group at Ensinore Glen, Owasco lake, N. Y.

Dr. Charles Wachsmuth of Burlington, Iowa, informs me of having examined specimens of apparently the same species, said to have come from Hamilton group, Ontario, Canada.

A single calyx plate from High-point, Ontario Co., N. Y., has large, coarse tubercles, and the plate is evidently from a much larger specimen than any seen at Ithaca, or in the Hamilton group, it is probably a distinct species.

A few detached calyx plates with similar surface markings, but proportionately longer and narrower than those of *A. Ithacensis*, were found in another exposure of the rocks near Ithaca.

The tubercles were few and scattered, this may represent another species. The generic characters of this new type of Crinoid may be defined as follows :

Arthroacantha, nov. gen.

(From *'ἄρθρον*, articulation and *'ἄκανθα* spine.) Calyx obconical or broadly cup-shaped ; height about equal to the breadth. Basal disc broad, shallow, hexagonal, composed of three subequal plates.

Following the basal disc are six large subequal plates, five of which are primary radials, and the sixth is the anal.

The first radials are slightly higher than broad with gently diverging sides, the upper margin excavated by a deep covered notch occupying about one third the total width of the upper edge.

In this notch lie the second radials, small and short plates which arch outward and continue upward the rounded carination that begins on the upper part of the first radial.

The third radial is triangular, smaller than the second and supports the first plates of the free arms which start out from the radial at a broad angle.

The arms are ten, and, in the typical species are several times as long as the height of the calyx, and bifurcate at least twice, and broadly diverge at each branching.

They are composed of plates which are narrowly wedge-shaped at the base of the arm, the first two or three reach across the breadth of the arm, but seriatim they become shorter, the wedge points more blunt, and the outer portion of the margin more nearly parallel, and for the main part of the arm the plates interlock along the median line, forming a zigzag suture, the points of the plates from each side reaching less than two-thirds across the surface of the arm.

Each arm plate bears a slender pinnule of five or more joints.

The anals are a little narrower than the first radials, and have less diverging sides.

The vault is composed of numerous small plates, and was probably low and arching.

The surface of the calyx plates is beset with low scattered, rounded tubercles, pitted at the apex.

The same tubercles are seen on the plates of the vault, a single tubercle for each plate.

Upon the vault there are five narrow spaces, without tubercles, radiating from the center ; they consist of two rows of interlocking plates which were probably thinner than the spine-bearing plates ; all the intervening plates have tubercles.

Along the upper rim of the calyx is a row of small plates which lack the tubercles ; also, the tubercles are wanting on the second and third

radial plates. The arm plates pretty generally have a small tubercle for each plate, but there is an occasional exception.

From these tubercles proceed slender, acicular spines, bristling outward from the calyx and arms, and upward from the vault.

These spines were evidently movable, and articulated by ? ligaments or ? muscle upon the pitted tubercles. The spines are also pitted at their bases.

The typical species, *A. Ithacensis*, is from the base of the Chemung group at Ithaca, N. Y., from a fine, sandy shale, containing *Spirifera mesocostalis*, *Productella speciosa*, *Strophodonta mucronata*, and other Chemung fossils, and the specimens are in the museum of Cornell University.

Arthroacantha Ithacensis, n. s.

This name is proposed for the typical species upon which the genus *Arthroacantha* is founded, and the imperfection of the material and the actual variation among the few specimens seen create considerable doubt as to what may be the permanent characters which distinguish the typical form from other representatives of the genus. I will give therefore a particular account of the size and proportions of the parts of the typical specimens, and remark upon the variations observed.

The general shape and features are described in the generic diagnosis.

The typical species has the following dimensions:

	MM.	
Calyx, height	9.5	
breadth	13.5	
Arms, thickness at base	1.4	
estimated length	45.0	
Stem, thickness at junction with calyx	1.9	
Basal, radius from center of disc to base of 1st radial	4.5	
1st radial, height	4.5	
2d and 3d radials together	1.1	
1st radial, width at base	5.0	
" " top	7.0	
Tubercles, diameter about	0.6	
number on one basal plate		16–18
" " one 1st radial		21
Spines, length of longest	12.8	
diameter at base	0.4	

The arms have ten to fifteen joints before they bifurcate. The calyx plates are marked on the inside by several distinct lines parallel with each other and with the outline of the plate, arranged concentrically like lines of growth. This feature is not seen on the specimens from the Hamilton group.

There is considerable difference in size among the several specimens from the typical locality, though the majority of specimens are about the

dimensions given above. A large basal disk is seen with a radius of 12.2 mm., but with proportions of the other specimens.

Although the specimens show more or less distortion from pre-sure, it is evident that the basal disk formed a low shallow cup, the depth of which was about one-quarter the diameter.

The length of spines vary for the same individual. Those within the protection of the arms, from the vault plates, are more frequently preserved, and are longer than representatives of calyx spines seen on these specimens, but one calyx spine is thicker than any vault spine, and is broken off; judging from this and the larger size of the tubercles, it is probable that the calyx spines were fully as long and strong as those on the vault. The spines are all very straight, slender, acicular, tapering evenly to a sharp point, and are finely longitudinally striate on the surface.

The number of the tubercles to each plate varies somewhat, and, comparing specimens of different size, it seems probable that their distribution was uniform, and that the number increased with the size of the specimen.

This species differs from the *Arth. punctobrachiata* of the Hamilton group in the more distinct and less numerous tubercles on the surface of the calyx plates; the smaller size of the tubercles leads to the inference that the spines were smaller in the Hamilton form; the calyx plates were apparently thicker in the Chemung species, and the second and third radial of the specimen *Arth. punctobrachiata* are higher than those of *Arth. Ithacensis*.

In all these comparisons normal variation (of which we are ignorant), the effects of different habitat upon relative development of parts, and the distortion incident to fossilization, and the very limited and imperfect nature of the material, lead us to speak with diffidence both as to specific character and as to specific limits.

The character of movable spines, were it not so anomalous for the whole order, might be regarded as of only specific value; on the other hand, from a theoretical point of view it would not be unreasonable to establish a distinct family for Crinoids possessing this Echinoid character.

I have taken the view that for practical purposes the generic distinction of this from closely related genera is the best that can be done with the present material.

The character of a vault composed of two sets of plates arranged in ten radiating and alternate series is suggestive, and calls for further investigation.

I have discovered on one of the specimens—somewhat crushed, but exhibiting the main part of the vault and spines in place—five radiating rows of plates upon which there are no tubercles. In crushing, the folding has taken place along the line of these rays, from which it is inferred that these plates were thinner than the spine-bearing plates which fill the spaces between them. These smooth plates seem to consist of two rows

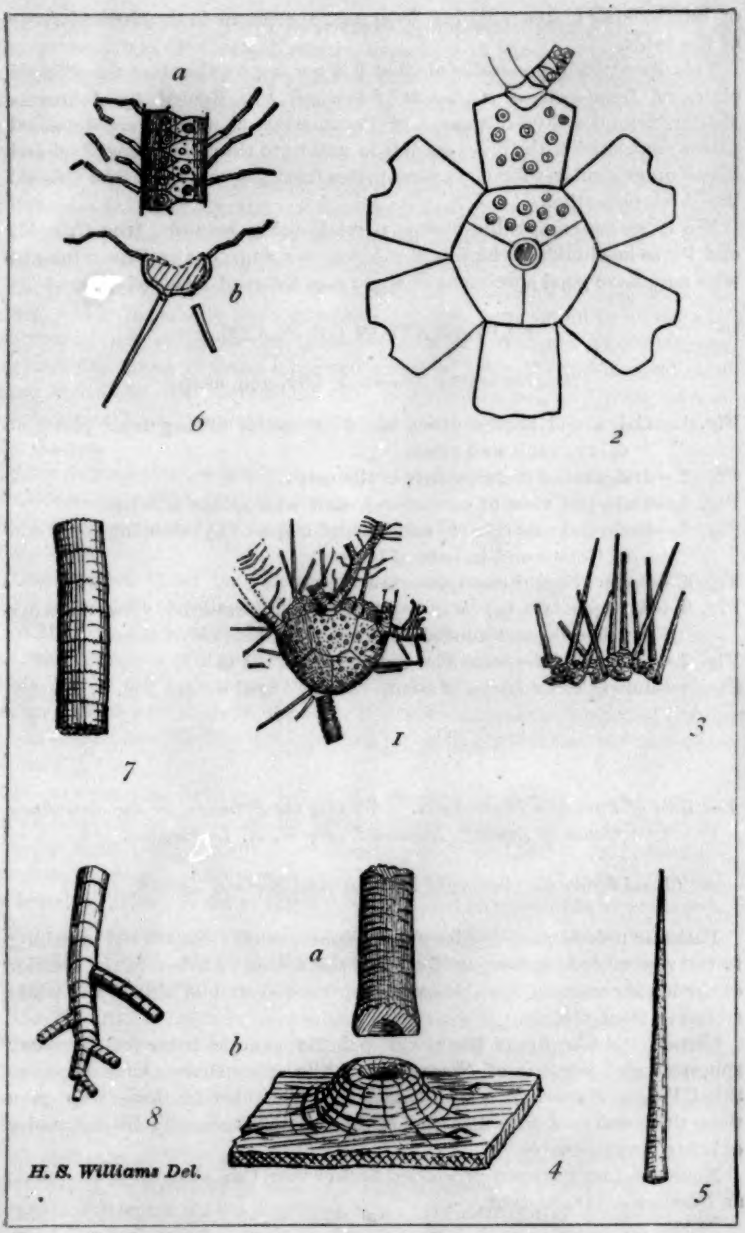


PLATE ILLUSTRATING ARTHROACANTHA ITHACENSIS, NOV. GEN. ET SP.

of interlocking plates radiating from near the center to the circumference of the vault.

This observation persuades me that it is not improbable that the original plates of *Lepidocentrus eifelianus*, described and figured by Johannes Müller, from the Eifel limestone of Rommersheim, which were detached plates associated with spines similar in nature to those just described and borne upon similar tubercles, were plates from the vault of a true Crinoid like Arthroacantha.

We have here a possible clue to a relationship between true Crinoids and Perischœchinidæ, which is worth following up by any palæontologist who may have good specimens of these rare forms of Echinodermata.

EXPLANATION OF PLATE.

Arthroacantha Ithacensis, nov. gen. et sp.

Fig. 1.—Calyx and part of arms, showing spines arising from plates of calyx, vault and arms.
Fig. 2.—Diagram of the elements of the calyx.
Fig. 3.—Enlarged view of part of the vault with spines attached.
Fig. 4.—Enlarged tubercle (*b*) and base of a spine (*a*), showing pit in top of former and in base of latter.
Fig. 5.—Spine about three times natural size.
Fig. 6.—Arm-plates. (*a*) A few joints of arm; external view, showing tubercles and jointed pinnules. (*b*) Section of same.
Fig. 7.—Section of the stem at a distance from the calyx.
Fig. 8.—Lower termination of stem. All enlarged except Fig. 1.

The Role of Parasitic Protophytes. Are they the Primary, or the Secondary Cause of Zymotic Diseases? By W. N. Lockington.

(*Read before the American Philosophical Society, April 6, 1883.*)

Parasitic unicellular organisms or microbes, usually considered to belong to the vegetable kingdom, are found, in some form or other, in the interior of the higher animals, both when in their normal state of health, and when suffering from disease.

Certain rod-like forms have received the generic name of *Bacillus;* spherical globules that of *Micrococcus*, while other shapes have been entitled *Vibrio*, *Bacterium*, and *Cladothrix*. The idea of those who gave these titles was evidently that each of these forms is actually distinct under existing circumstances.

Nomenclature has even proceeded farther than this, since such binomials as *Bacillus anthracis* exist.

During the last few years the microscope has been largely employed in the investigation of diseased tissues, especially in cases of those diseases called "zymotic;" and the result of this examination has been to show that certain specific forms of disease are invariably accompanied by what appear to be specific types of microbes—or at any rate by types that are constant in their relation to the disorder they accompany.

In this way Pasteur has made us acquainted with the parasite which accompanies anthrax, charbon, or malignant pustule, and with some others, Laveran has described and figured that of malaria, and Koch has shown that consumption has also its parasitic companion.

So generally have special forms been found associated with special diseases, and so invariably have these special forms been found to increase in number of individuals as the disease with which they are associated has increased in severity, that a large proportion of scientific and medical men have arrived at the conclusions that every *inflammatory* disease (if not every disease) has its *specific* parasite; and that the parasite is the cause of the disease.

This explanation certainly lies upon the face of the facts, but a little consideration will show that neither the *specific* nature of the parasite, nor its direct causation of the disease, are proved by any series of observations yet on record.

Observations upon the *higher* animals have conclusively proved that they are subject to considerable changes caused by their environment.

Within the limits of a single so-called species occur so many variations that the definition of a species has become difficult. Besides those variations due to sex and to age; individual, racial, and varietal differences occur, to such an extent as to render the systematic arrangement of living forms a most bewildering task, and one respecting which no two biologists agree.

These variations right and left of the average of a species are admitted on all hands to be produced by natural forces, organic and inorganic, by gravity, heat, cold, moisture or drouth, plenty or lack of food, confinement or freedom, cultivation (which is an environment of man's making) or heredity, which is the effect of the continued environment of ancestors.

No man can look dispassionately at his own physical and mental condition without acknowledging that, leaving heredity aside, he is what he is on account of what he has experienced.

The changes of cell-structure which take place in the arm of a man who abandons the yard-measure for the blacksmith's hammer would, could they be examined with the microscope in the same way that we can watch the changes of an amœba, be seen to be a thousand-fold greater and more complicated than those of that rhizopod.

As instances of what a change of environment can do in creatures built up of many thousand cells, each cell as complex as is the entirety of the parasitic organisms we are inquiring into, the following will suffice: The

same species of trout attains a larger size in large rivers than in small streams; anadromous salmon of a large species have, when by accident confined within a small fresh-water lake, in a few years so altered, becoming sexually mature when quite small, that a naturalist who did not know the cause might take them for a new species; fishes confined within a space so narrow that normal growth was impossible, yet supplied with food, have grown to fit the space; the clear silvery tints and graceful forms of salmon when in the sea are so unlike the muddy colors and misshapen outlines presented by the same individuals after ascent of a river that observers have founded on them many false species; and the larva of the conger eel becomes at times converted into a transparent, colorless pelagic fish that has received the name of *Leptocephalus Morrisii*.

Is it not reasonable to suppose that the outline of a plastic atom of protoplasm, bounded only by a delicate pellicle, is more readily amenable to the influences surrounding it than that of the million-celled creatures which are known to change so greatly?

The vegetable kingdom offers examples of variation as striking as those of the animal.

It is as hard to find two leaves of the same plant exactly alike as it is to find two Dromios. The stem-leaves and root-leaves of the same herbaceous plant differ more from each other than from the corresponding leaves of a kindred species. In some trees, as the ivy and the mulberry, the play of form is so great, that one unacquainted with the facts would certainly believe that forms gathered from the same stem belonged to different species. Each leaf, as truly as each human being, has its own particular environment, its share of light, heat, nutrition, etc., and these work changes in its form.

The change effected by the environment upon a plant goes further than form, size, or color, and extends to the nature of its secretions, so that plants which, when grown under certain conditions, are good food for man and beast, become toxic under other conditions. This is true of many of our garden vegetables; and, to come nearer to our microscopic organisms, it is true of certain many-celled fungi, such as the common agaric of the meadows.

In the latter case the fungus is on all hands allowed to be the same, yet while one specimen it innocuous, another is toxic.

Would it be very remarkable if it should be proved that an innocent one-celled microbe, surrounded with diseased and poisonous pabulum, should, if able to resist the influences around it without perishing, become poisonous itself?

Against the usual form of the germ theory, with its specific germs inducing specific diseases, it is allowable to put forth the following:

The microbes that swarm within the body of the victim of a zymotic disease, are either the lineal descendants of those which inhabited the same body when in health, or are the lineal descendants of those which once dwelt in some other

body when in health; and, if poisonous in their nature, have been so rendered by the poisonous nature of the secretions around them.

Organisms placed in the midst of matter that has undergone a chemical change, and accustomed to feed upon the products of disease, are likely to introduce that disease if themselves introduced into a previously healthy body.

Their substance is permeated with the diseased secretions, their surface is covered with them. They have fed upon abnormal products, therefore they excrete abnormal products, and, if placed within a healthy animal, are apt to start within it the same unhealthy metabolism to which they are acclimated.

Even if the parasitic germs have not themselves yet become toxic, it is a physical impossibility to introduce them unaccompanied by the virus that surrounds and permeates them.

Yet the primary cause of the disease is an abnormal change in the processes of life, affecting first the animal, and afterwards the parasite.

All analogy is, as has been shown, in favor of this view, and no observations yet made have weakened, still less disproved, analogies in harmony with evolutional facts.

Many well-known medical men, notably Dr. Lionel Beale, and Dr. Benjamin Richardson, refuse to believe in the potency of mysterious specific germs peopling air, water and soil, and ready at any moment to enter upon a work of wholesale destruction, and recently Dr. Formad, of this city, has announced his adherence to the older and more rational view, at least in the case of consumption.

We need no microscope, and no doctor, to assure us that germs are not the primary cause of most of the ills that flesh is heir to. He would be a bold man who would dare attribute the evils following excessive indulgence of any kind to the presence of parasites; the catarrh that follows facing a rough north-easter, or "cooling off" in a draught can scarcely be due to germs; nor can the pneumonia that succeeds a thorough wetting and chilling; the rheumatism of the muscular man who has habitually exposed himself to cold and damp; or the headache that punishes intellectual excess, be set down as caused by microbes.

Yet these disorders are accompanied with more or less of that inequality of the bodily processes, that undue activity in one spot, and stagnation in another, which constitutes inflammation; and there is little doubt that, were a microscopic examination made, it would be found that microbes were present, probably in larger numbers than usual in a state of health.

Between these ordinary ailments and epidemic diseases there is no provable distinction in kind. The products of disease, whether particles of the diseased organism, or parasites become diseased by a residence in that organism, are dangerous to the health of others, and the danger increases in proportion to the virulence of the disease.

Diseases are processes of dissolution, and dissolution must occur, sooner or later, as the complement of individual evolution.

The role of microscopic parasites is probably similar to that of the more tangible *tæniæ* and other worms that live as commensals within the body, devouring the nutriment intended for it; or, at the very worst, they are feeders upon the secretions of their host. In either case, they are fed at his expense. To one in thorough health they do little harm, but become a burden to those of weaker powers, and may become, in those attacked with a grave disorder, so diseased themselves that they may act as carriers of the disease to previously healthy bodies.

The power possessed by these parasites, taken from the victim of an infectious disease, of producing descendants which, for several generations, are capable of reproducing that disease, is often pointed to as a proof both of the specific nature of the parasite, and of its potency as the primary cause of the disease.

Yet these facts, when looked at properly, tend to prove the reverse.

The presumably toxic microbes, removed from their accustomed pabulum, reproduce themselves, it is true, in healthy infusions, which by their presence are rendered toxic, but at each removal to a fresh environment some of the toxic power is lost, until at last the virus has become so attenuated that it can safely be used as a medium of inoculation (as has been practised largely by Pasteur upon domestic animals) reproducing the original disease in a mild form, and thus (in some way not easy to explain) ensuring the subjects treated with it against the fatal form of the disease.

What is this gradual enfeeblement of the toxic powers of the parasite but its gradual return toward its normal condition—toward the neutral properties and probably toward the external appearance presented by its ancestors when they dwelt within a healthy animal?

Let the cultivation proceed for a sufficient number of generations, and the reversion will be comp'ete.

Observers, principally chemists, who have studied the microbes of disease, have figured their forms, and in some cases have registered the transformations of a generation; but much more than this is necessary to prove their specific distinctness, or their direct connection with the disease.

If, after an examination of hundreds of individual animals, some in health, others in every stage between health and the crisis of the disease, and others in the various stages of recovery, no transition form is in any one instance noted—no microbe intermediate in character between that of health and that found in the disease; the evidence, though still negative, will be in favor of the ordinary germ theory, but if in only one animal among hundreds intermediate forms are found, that one instance will be positive evidence in favor of the views here advocated; since the diseased form, when once produced, can reproduce its characters for several generations.

Microscopic examinations of the cultured organisms up to the hundredth generation would throw some light on the subject.

Identity between a micrococcus-form and *bacillus*-form has already been noted.

M. Miguel, who has recently studied in a most thorough manner the germs found in the air, gives figures of the development of an organism which, at one stage of its life, has all the characters of a very long *bacillus*, and afterwards by segmentation into spherules of equal size, forms chaplets of *micrococci*, liable to separate into small groups.

The editor of the *Revue Scientifique*, that stronghold of the microbe contagion theory, admits, in a late issue, that the forms found in disease are probably varieties of habitat, and not species, yet still considers them as the cause of the diseases they accompany.

After admitting the great variability of these simple organisms, in accordance with their habitat, is it not arguing in a circle to maintain that varieties caused by certain conditions are themselves the primary cause of those conditions?

On the Reversion of Series and its Application to the Solution of Numerical Equations. By J. G. Hagen, S. J. Prof. College of the Sacred Heart, Prairie du Chien, Wisconsin.

(*Read before the American Philosophical Society, April 6, 1883.*)

In a treatise entitled "Die allgemeine Umkehrung gegebener Functionen," which was published in 1849, Professor Schlömilch maintains, that all the methods of reversing series, based upon the theory of Combinations, fail in the point of *practical application* and that even Lagrange's formula presents an *unfavorable form* of such reversions. The author then proceeds to develop two new methods of reversing any given function, the one by means of Fourier's series, the other by definite integrals. In a theoretical view, Professor Schlömilch's methods are no doubt preferable to all the ancient ones on account of both their generality and their simplicity; yet when there is question about computing the numerical values of the coefficients of a reversed series, it should not be forgotten, that in most cases these definite integrals, in spite of their elegant form, can not be computed except by development, thus in many cases causing even greater trouble than the old method of combinations in the case of algebraic functions.

The treatise here published does not claim to furnish a new method, but is intended to give the recurring formula for determining the coefficients of the reversed series such a perspicuous form as to render its practical application easy, and then to apply the same to the solution of numerical equations.

Part I.

§1. Given the series $\mathfrak{X} = \sum_{r=0}^{r=m} A_r y^r$, to find the reversed series $y = \sum_{\delta=0}^{\delta=\mu} B_\delta \mathfrak{X}^\delta$, where μ and B are unknown. Replacing y by the latter series, we obtain

$$\mathfrak{X} = \sum_{r=0}^{r=m} A_r \left[\sum_{\delta=0}^{\delta=\mu} B_\delta \mathfrak{X}^\delta \right]^r$$ or, applying Waring's formula,

$$\mathfrak{X} = \sum_{r=0}^{r=m} A_r \pi(r) \sum_{a,r} \frac{B_0^{a_0} B_1^{a_1} \ldots B_\mu^{a_\mu}}{\pi(a_0)\pi(a_1)\ldots\pi(a_\mu)} \mathfrak{X}^{0a_0 + 1a_1 + 2a_2 + \ldots + \mu a_\mu}$$

In the formula, $\pi(r) = 1 \cdot 2 \cdot 3 \ldots r$, according to the notation of *Gauss*, and the series $a_0, a_1 \ldots a_\mu$ represents all such combinations of the numbers 0, 1, 2, 3, ... r as satisfy the condition

$$a_0 + a_1 + a_2 + \ldots + a_\mu = r.$$

The last formula is an identical equation and, according to the theorem of Indeterminate Coefficients, may be resolved into the following conditions:

1. Case. $0a_0 + 1a_1 + 2a_2 + \ldots + \mu a_\mu = 0.$

This equation admits of the following combinations:

a_0	a_1	a_2	a_3	r
0	0	0	0	0
1	0	0	0	1
2	0	0	0	2
.	.	.	.	.

hence we have the condition

$$\sum_{r=0}^{r=m} A_r \pi(r) \frac{B_0^r}{\pi(r)} = 0 \text{ or } \sum_{r=0}^{r=m} A_r B_0^r = 0. \qquad (1)$$

Though this equation is of the mth degree with regard to B_0, yet for the reversion of series, but one of its roots is fit, because there is *but one way of developing y into a series of ascending powers of* $\mathfrak{X}$, and indeed we find that B_0 is to satisfy still another condition.

Putting $y = 0$ we have $\mathfrak{X} = A_0$, hence

$$\sum_{\delta=0}^{\delta=\mu} B_\delta A_0^\delta = 0.$$

In the special case $A_0 = 0$ we have $B_0 = 0$.

2. Case. $0a_0 + 1a_1 + 2a_2 + \ldots + \mu a_\mu = 1.$

This case admits of the following combinations:

a_0	a_1	a_2	a_3	a_4	r
0	1	0	0	0	1
1	1	0	0	0	2
2	1	0	0	0	3
.	.	.	.	.	.

Hence we have the second condition

$$\sum_{r=o}^{r=m} A_r\,\pi(r)\;\frac{B_0\;B_1}{\pi(r-1)} = 1. \qquad (2)$$

3. Case. $0a_0 + 1a_1 + 2a_2 + \ldots + \mu\,a_\mu = 2.$

This equation admits of the combinations:

a_0	a_1	a_2	a_3	a_4	r	a_0	a_1	a_2	a_3	a_4	r
0	0	1	0	0	1	0	2	0	0	0	2
1	0	1	0	0	2	1	2	0	0	0	3
2	0	1	0	0	3	2	2	0	0	0	4
.	.	.	.	.	.	.	.	.	.	.	.

Hence the third condition is

$$\sum A_r\,\pi(r)\left[\frac{B_0^{r-1}\,B_2}{\pi(r-1)\;\pi(1)} + \frac{B_0^{r-2}\,B_1^2}{\pi(r-2)\;\pi(2)}\right] = 0. \qquad (3)$$

4. Case. $0a_0 + 1a_1 + 2a_2 + \ldots + \mu\,a_\mu = 3.$

The combinations of this case are the following:

a_0	a_1	a_2	a_3	a_4	a_5	r	a_0	a_1	a_2	a_3	a_4	a_5	r	a_0	a_1	a_2	a_3	a_4	a_5	r
0	0	0	1	0	0	1	0	1	1	0	0	.	2	0	3	0	0	etc.		3
1	0	0	1	0	0	2	1	1	1	0	0	.	3	1	3	0	0			4
2	0	0	1	0	0	3	2	1	1	0	0	.	4	2	3	0	0			5
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			.

Hence the fourth condition

$$\sum_{r=o}^{r=m} A_r\,\pi(r)\left[\frac{B_0^{r-1}\,B_r}{\pi(r-1)\;\pi(1)} + \frac{B_0^{r-2}\,B_1 B_2}{\pi(r-2)\;\pi(1)\;\pi(1)} + \frac{B_0^{r-3}\,B_1^3}{\pi(r-3)\;\pi(3)}\right] = 0. \qquad (4)$$

5. Case. $0a_0 + 1a_1 + 2a_2 + \ldots + \mu\,a_\mu = 4.$

Here we have the following possible combinations:

a_0	a_1	a_2	a_3	a_4	a_5	r
0	0	0	0	1	0	1
1	0	0	0	1	0	2
2	0	0	0	1	0	3
.	.	.	.	.	.	.

a_0	a_1	a_2	a_3	r
0	1	0	1	2
1	1	0	1	3
2	1	0	1	4
.	.	.	.	.

a_0	a_1	a_2	a_3	r
0	2	1	0	3
1	2	1	0	4
2	2	1	0	5
.	.	.	.	.

a_0	a_1	a_2	r
0	4	0	4
1	4	0	5
2	4	0	6
.	.	.	.

a_0	a_1	a_2	a_3	r
0	0	2	0	2
1	0	2	0	3
2	0	2	0	4
.	.	.	.	.

Hence the fifth condition:

$$\sum_{r=o}^{r=m} A_r\,\pi(r)\left[\frac{B_0^{r-1}\,B_4}{\pi(r-1)\;\pi(1)} + \frac{B_0^{r-2}}{\pi(r-2)}\left(\frac{B_1 B_2}{\pi(1)\;\pi(1)} + \frac{B_2^2}{\pi(2)}\right) + \frac{B_0^{r-3}\,B_1^2\,B_2}{\pi(r-3)\;\pi(2)\pi(1)}\right.$$

$$+\frac{B_0^{r-4}\,B_{(4)}}{\pi(r-4)\,\pi(4)}\Big] = 0, \qquad (5)$$

and so on.

Note.—The lower limit of r may be put $= 0$, because all those terms in which π contains a *negative* argument, are zero.

§2. The equations (1) to (5) may be transformed in the following way. We put for brevity's sake

$$\Sigma_\delta = \sum_{r=\delta}^{r=m} \binom{r}{\delta} A_r\, B_0^{r-\delta} = A_\delta + \ldots, \qquad (6)$$

where

$$\binom{r}{\delta} = \frac{r\,(r-1)\,(r-2)\ldots(r-\delta+1)}{1\,.\,2\,.\,3\,\ldots\,\delta}$$

according to the notation of *Euler.** For numerical computations we then obtain from (6)

$$\left.\begin{aligned} \Sigma_1 &= A_1 + 2\,A_2\,B_0 + 3\,A_3\,B_0^2 + 4\,A_4\,B_0^3 + \ldots \\ \Sigma_2 &= A_2 + 3\,A_3\,B_0 + 6\,A_4\,B_0^2 + \ldots \\ \Sigma_3 &= A_3 + 4\,A_4\,B_0 + \ldots \\ \Sigma_4 &= A_4 + \ldots \end{aligned}\right\} \qquad (7)$$

Thus the conditions (1) to (5) present themselves in the more perspicuous forms

$$\left.\begin{aligned} &\Sigma_0 = 0 \\ &B_1\,\Sigma_1 = 1 \\ &B_2\,\Sigma_1 + B_1^2\,\Sigma_2 = 0 \\ &B_3\,\Sigma_1 + 2\,B_1\,B_2\,\Sigma_2 + B_1^3\,\Sigma_3 = 0 \\ &B_4\,\Sigma_1 + 2\,(B_1\,B_3 + \tfrac{1}{2}\,B_2^2)\,\Sigma_2 + 3\,B_1^2\,B_2\,\Sigma_3 + B_1^4\,\Sigma_4 = 0. \end{aligned}\right\} \qquad (8)$$

The law of these series being evidenced from inspection, we deduce the next following conditions :

$$B_5\,\Sigma_1 + 2\,(B_1\,B_4 + B_2\,B_3)\,\Sigma_2 + 3\,(B_1^2\,B_3 + B_2^2\,B_1)\,\Sigma_3 + 4\,B_1^3\,B_2\,\Sigma_4 + B_1^5\,\Sigma_5 = 0$$

$$B_6\,\Sigma_1 + \pi(2)\,(B_1B_5 + B_2B_4 + \frac{B_3^2}{\pi(2)})\,\Sigma_2 + \pi(3)\,(B_1B_2B_3 + \frac{B_1^2}{\pi(2)}\,B_4 + \frac{B_2^3}{\pi(3)})$$
$$\times\,\Sigma_3 + \pi(4)\Big(\frac{B_1^3}{\pi(3)}\,B_3 + \frac{B_1^2}{\pi(2)}\,\frac{B_1^2}{\pi(2)}\Big)\,\Sigma_4 + 5\,B_1^4\,B_2\,\Sigma_5 + B_1^6\,\Sigma_6 = 0,$$

and in the general form

$B_\mu\,\Sigma_1 + \pi(2)(B_1\,B_{\mu-1} + \ldots)\,\Sigma_2 + \pi(3)(B_1 \ldots .)\,\Sigma_3 + \ldots + B_1^\mu\,\Sigma_\mu = 0$, each term with the sign Σ_ν having the factor $\pi(\nu)$ and each B^σ having the denominator $\pi(\sigma)$. The factors of Σ_ν are always ν in number, and the sum of their indices μ.

There is no difficulty in solving the equations (8), except the first,

* Acta Petropolitana, V. 1, p. 89. Though his notation is not much used in American text-books, it is found very handy in operating on series.

which is of the mth degree and will be considered presently. The other equations give the following solutions:

$$\left.\begin{aligned} B_1 &= +\frac{1}{\Sigma_1} \\ B_2 &= -\frac{1}{\Sigma_1^3}\,\Sigma_2 \\ B_3 &= +\frac{1}{\Sigma_1^5}\,(2\,\Sigma_2^2 - \Sigma_1\,\Sigma_3) \\ B_4 &= -\frac{1}{\Sigma_1^7}\,(5\,\Sigma_2^3 - 5\,\Sigma_1\,\Sigma_2\,\Sigma_3 + \Sigma_1^2\,\Sigma_4), \text{ etc.} \end{aligned}\right\} \quad (9)$$

The formulas show, first, that in general we shall have $\mu = \infty$, and secondly, that the series of the coefficients B decreases the faster the larger Σ_1 is. For the quotient $B_{\mu+1} \div B_\mu$ is of the same order as $1 \div \Sigma_1$. Hence a few terms will suffice to compute y as often as the coefficient A_1 is large in comparison to the following coefficients.

Now as to the condition

$$\Sigma_0 = \sum_{r=0}^{r=m} A_r\, B_0\, B_0^r = 0,$$

it is evident that its *exact* solution is impossible as often as $m > 4$, except in one case, viz.: when $A_0 = 0$, in which we have also $B_0 = 0$. The approximate solution of the above equation by development will be explained in Part II.

§3. In the special case $A_0 = 0$ we have $B_0 = 0$, because x and y are zero at the same time. Consequently we have $\Sigma_\delta = A_\delta$ and the formulas (8) may be written in the form

$$\left.\begin{aligned} &B_0 = A_0 = 0 \\ &B_1\,A_1 = 1 \\ &B_2\,A_1 + B_1^2\,A_2 = 0 \\ &B_3\,A_1 + 2\,B_1\,B_2\,A_2 + B_1^3\,A_3 = 0 \\ &B_4\,A_1 + 2\,(B_1\,B_3 + \tfrac{1}{2}\,B_2^2)\,A_2 + 3\,B_1^2\,B_2\,A_3 + B_1^4\,A_4 = 0 \\ &B_5\,A_1 + 2\,(B_1\,B_4 + B_2\,B_3)\,A_2 + (B_1^2\,B_3 + B_2^2\,B_1)\,A_3 + \\ &\qquad 4\,B_1^3\,B_2\,B_4 + B_1^5\,A^5 = 0 \end{aligned}\right\} \quad (8')$$

etc., their solutions being

$$\left.\begin{aligned} B_1 &= +\frac{1}{A_1} \\ B_2 &= -\frac{1}{A_1^3}\,A_2 \\ B_3 &= +\frac{1}{A_1^5}\,(2\,A_2^2 - A_1\,A_3) \\ B_4 &= -\frac{1}{A_1^7}\,(5\,A_2^3 - 5\,A_1\,A_2\,A_3 + A_1^2\,A_4), \text{ etc.} \end{aligned}\right\} \quad (9')$$

Part II.

§4. When A_0 is not zero, the given series may be written in the form

$$x - A_0 = \sum_{r=1}^{r=m} A_r\, y^r \qquad (10)$$

Here we have exactly the case of §3 and the formulas (9′) will at once give the coefficients of the series

$$y = \sum_{\delta=0}^{\delta=\mu} B_\delta (\varkappa - A_0)^\delta. \qquad (10')$$

§5. When it is required to have y developed into a series of ascending powers of $\varkappa$ itself, we may proceed in the following way. Let the given series be written in two different ways,

$$\varkappa = \sum_{r=0}^{r=m} A_r y^r \text{ and } \varkappa - A_0 = \sum_{r=1}^{r=m} A_r y^r,$$

and consequently also the reversed series

$$y = \sum_{\delta=0}^{\delta=\infty} B_\delta \varkappa^\delta \text{ and } y = \sum_{\delta=0}^{\delta=\infty} C_\delta (\varkappa - A_0)^\delta. \qquad (11)$$

The values of the C are given by the formulas (9′), provided that we write C instead of B, as has been explained in §4, while the coefficients B are still unknown. Developing $(\varkappa - A_0)^\delta$ by the Newtonian formula, we get

$$(\varkappa - A_0)^\delta = (-1)^\delta \sum_{\lambda=0}^{\lambda=\infty} (-1)^\lambda \binom{\delta}{\lambda} A_0^{\delta-\lambda} \varkappa^\lambda;$$

and equating the two series (11), we obtain

$$\sum_{\delta=0}^{\delta=\infty} B_\delta \varkappa^\delta = \sum_{\lambda=0}^{\lambda=\infty} (-1)^\lambda \varkappa^\lambda \sum_{\delta=0}^{\delta=\infty} (-1)^\delta C_\delta \binom{\delta}{\lambda} A_0^{\delta-\lambda};$$

and finally by the theorem of *Indeterminate Coefficients*,

$$B_\lambda = (-1)^\lambda \sum_{\delta=\lambda}^{\delta=\infty} (-1)^\delta \binom{\delta}{\lambda} C_\delta A_0^{\delta-\lambda} \qquad (12)$$

This formula may be transformed, by changing the index $\delta = \lambda + r$, thus:

$$B_\lambda = (-1)^\lambda \sum_{r=0}^{r=\infty} (-1)^{\lambda+r} \binom{\lambda+r}{\lambda} C_{\lambda+r} A_0^r, \qquad (12')$$

where instead of $\binom{\lambda+r}{\lambda}$ we may write $\binom{\lambda+r}{r}$. The *convergence* of the series (12) will depend upon the coefficients C and must be examined in each special case; in general we can state that it always converges, when we have

$$\lim_{\alpha=\infty} \frac{C_{\delta+1}}{C_\delta} < \pm \frac{1}{A_0}$$

Example.—Let it be required to reverse the series

$$\varkappa = 1 + \tfrac{1}{1} y + \tfrac{1}{2} y^2 + \tfrac{1}{3} y^3 + \cdots$$

Here is $A_\delta = \frac{1}{\delta}$ $(\delta > 0)$ and $A_0 = 1$, hence we obtain from (9′), writing C instead of B,

$$C_0 = 0,\ C_1 = 1,\ C_2 = -\frac{1}{\pi(2)},\ C_3 = +\frac{1}{\pi(3)},\ C^4 = -\frac{1}{\pi(4)},\ \text{etc.},$$

and in general (except C_0)

$$C_\delta = (-1)^{\delta+1}\frac{1}{\pi(\delta)} \text{ or } C_{\lambda+r} = \frac{(-1)^{\lambda+r+1}}{\pi(\lambda+r)}.$$

This value substituted in (12′) gives for $\lambda > 1$

$$B_\lambda = (-1)^{\lambda+1}\sum_{r+o}^{r+\infty}\binom{\lambda+r}{\lambda}\frac{1}{\pi(\lambda+r)} = \frac{(-1)^{\lambda+1}}{\pi(\lambda)}\sum_{r=o}^{r=\infty}\frac{1}{\pi(r)} =$$

$$\frac{(-1)^{\lambda+1}}{\pi(\lambda)} \times e,$$

and for $\lambda = 0$, since $C_0 = 0$,

$$B_0 = -\sum_{r=1}^{r=\infty}\frac{1}{\pi(r)} = 1 - \sum_{r=o}^{r=\infty}\frac{1}{\pi(r)} = 1 - e;$$

where $e = 2.718281828 +$ is the base of, the *Nepierian* system of logarithms.

Substituting these values into the first of the formulas (11) we obtain

$$y = \sum_{\lambda=o}^{\lambda=\infty} B_\lambda \varkappa^\lambda = 1 - e + e\sum_{\lambda=1}^{\lambda=\infty}\frac{(-1)^{\lambda+1}}{\pi(\lambda)}\varkappa^\lambda.$$

Consequently the given series

$$\varkappa = 1 + \frac{y}{1} + \frac{y^2}{2} + \frac{y^3}{3} + \frac{y^4}{4} + \ldots = 1 + \sum_{r=1}^{r=\infty}\frac{y^r}{r}$$

is reversed in the following way:

$$y = 1 - e\left(1 - \frac{\varkappa}{1} + \frac{\varkappa^2}{1.2} - \frac{\varkappa^3}{1.2.3} + \frac{\varkappa^4}{1.2.3.4} - \ldots\right)$$

$$= 1 - e\sum_{r=o}^{r=\infty}(-1)^r\frac{\varkappa^r}{\pi(r)}.$$

This last formula may be tested in the following way. The given series requires that we have at the same time $\varkappa = 1$ and $y = 0$, consequently the reversed series requires the identity

$$1 - \frac{1}{1.2} + \frac{1}{1.2.3} - \frac{1}{1.2.3.4} + \ldots = \frac{e-1}{e},$$

which may be verified without difficulty.

Part III.

The equations (10) and (10′) imply the *approximate solution of algebraic equations*. Putting $A_0 = 0$ and assuming for $\varkappa$ any constant quantity, say a, we may write these equations in the following way:

$$a = \sum_{r=1}^{r=m} A_r y^r, \text{ solution, } y = \sum_{\delta=o}^{\delta=\mu} B_\delta a^\delta \qquad (13)$$

The coefficients B are determined by the equations (8) and (9). We do not say (8′) and (9′), because the condition $B_0 = 0$ is not by necessity fulfilled in this case, although we have $A_0 = 0$. While in §1 we have stated that the reversion of the series admits of but one root of the equation (1), since there is but one way of developing y into a series of ascending powers of $\varkappa$, we now have to say, that all the m roots of

the equation (1) are to be considered, since our equation (13) of the mth degree admits of m solutions. And indeed, equation (13) being no more an identity, we cannot say, as we did in §3, that a and y will be zero at the same time.

Consequently the condition (1) is be taken in its full extent and, since $A_0 = 0$, may be written this way:

$$\sum_{r=1}^{r=m} A_r B_0^r = 0 \qquad (14)$$

This equation is at once resolved into the following two:

$$B_0 = 0 \text{ and } \sum_{r=1}^{r=m} A_r B_0^{r-1} = 0, \qquad (14')$$

thus showing that *the solution of the equation of the mth degree is made dependent on the solution of an equation of the* $(m-1)$*th degree*, as has been remarked also by Prof. Schlömilch on page 26 of his article referred to. For each root B_0 the formulas (7) and (8) will furnish a different set of coefficients $B_1 B_2 \ldots$ and consequently a different value of y, and the formulas (9′) give at once the value of y for the root $B_0 = 0$:

$$y = +\frac{1}{A_1} a - \frac{1}{A_1^3} A_2 a^2 + \frac{1}{A_1^5} (2 A_2^2 - A_1 A_3) a^3 - \frac{1}{A_1^7} (5 A_2^3 - 5 A_1 A_2 A_3 + A_1^2 A_4) a^4 + \ldots . \qquad (15)$$

As we have already noted in §2, this method is applicable especially to such series in which the first coefficient A_1 is large in comparison to the following ones.

First example.—Let the given equation be

$$y^2 + 10 y + 1 = 0.$$

Here we have $A_2 = 1$, $A_1 = 10$, $a = -1$, and from (14′) we get the two conditions $B_0 = 0$ and $B_0 = -10$. By the first we obtain from (15)

$$y_1 = -\frac{1}{10} - \frac{1}{10^3} - \frac{2}{10^5} - \frac{5}{10^7} - \ldots = -.1010205 \ldots .$$

By the second condition $B_0 = -10$, we compute from (7)

$$\Sigma_1 = -10, \ \Sigma_2 = 1, \ \Sigma_3 = 0, \text{ etc.};$$

and by means of these values from (8) or (9)

$$B_1 = -\frac{1}{10}, \ B_2 = \frac{1}{10^3}, \ B_3 = -\frac{2}{10^5}, \ B_4 = \frac{5}{10^7}, \text{ etc.};$$

and finally we have from (13)

$$y_2 = -10 + \frac{1}{10} - \frac{1}{10^3} + \frac{2}{10^5} - \frac{5}{10^7} + \ldots = -9.8989795 \ldots$$

A proof of this calculation is found in that $y_1 + y_2$ is equal to the negative cofficient of y.

Second example.—Let it be required to solve the equation of the fourth degree

$$y^4 - 4 y^3 - 25 y^2 + 100 y + 1 = 0.$$

Here we have $A_4 = 1$, $A_3 = -4$, $A_2 = -25$, $A_1 = 100$, $a = -1$.

The equations (14) are now

$$B_0 = 0 \text{ and } B_0^3 - 4 B_0^2 - 25 B_0 + 100 = 0.$$

The latter admits of being resolved in the following way:

$$B_0^3 - 4\,B_0^2 - 25\,B_0 + 100 = (B_0^2 - 25)\,(B_0 - 4),$$

and thus we obtain for B_0 the following numerical values 0, −5, +4, +5.

1. By the first we obtain from (15)

$$y_1 = -\frac{1}{100} + \frac{25}{100^3} - \frac{1650}{100^5} + \frac{118125}{100^7} - \ldots$$
$$= -.009,975,163,8\ldots$$

2. By the second we compute from (7)

$$\Sigma_1 = -450,\ \Sigma_2 = +185,\ \Sigma_3 = -24,\ \Sigma_4 = 1,\ \Sigma_5 = 0,\ \text{etc.},$$

and consequently from (8) or (9)

$$B_1 = -\frac{1}{450},\ B_2 = +\frac{185}{450^3},\ B_3 = -\frac{57650}{450^5},\ \text{etc.},$$

and finally from (13)

$$y_2 = -5 + \frac{1}{450} + \frac{185}{450^3} + \frac{57650}{450^5} + \ldots$$
$$= -4.997,775,744,5\ldots$$

3. In the third case $B_0 = +4$ we find from (7)

$$\Sigma_1 = -36,\ \Sigma_2 = +23,\ \Sigma_3 = +12,\ \Sigma_4 = 1,\ \Sigma_5 = 0,\ \text{etc.},$$

and from (9)

$$B_1 = -\frac{1}{36},\ B_2 = \frac{23}{36^3},\ B_3 = -\frac{1490}{36^5},\ B_4 = \frac{80707}{36^7},\ \text{etc.};$$

hence from (13)

$$y_3 = 4 + \frac{1}{36} + \frac{23}{36^3} + \frac{1490}{36^5} + \frac{80707}{36^7} + \ldots$$
$$= 4.028,296,8\ldots.$$

4. In the fourth case $B_0 = +5$ we have from (7)

$$\Sigma_1 = +50,\ \Sigma_2 = +65,\ \Sigma_3 = +16,\ \Sigma_4 = 1,\ \Sigma_5 = 0,\ \text{etc.},$$

and from (9)

$$B_1 = \frac{1}{50},\ B_2 = -\frac{65}{50^3},\ B_3 = \frac{7650}{50^5},\ B_4 = -\frac{1115625}{50^7},\ \text{etc.};$$

consequently:

$$y_4 = 5 - \frac{1}{50} - \frac{65}{50^3} - \frac{7650}{50^5} - \frac{1115625}{50^7} - \ldots$$
$$= +4.979,453,9\ldots$$

A proof of the work is found in the sum of the four roots,

$$\begin{aligned} y_1 &= -0.009,975,163,8 \\ y_2 &= -4.997,775,744,5 \\ y_3 &= +4.028,296,8 \\ y_4 &= +4.979,453,9 \\ \hline &+4.000,000, \end{aligned}$$

inclusive of the sixth decimal place being equal to the negative coefficient of y^3.

On the Conversion of Chlorine into Hydrochloric Acid, as observed in the Deposition of Gold from its Solutions by Charcoal. By Wm. Morris Davis.

(Read before the American Philosophical Society, April 6, 1883.)

The simple fact of such conversion, while of interest in a chemical point of view, would not justify me in occupying the time of this meeting in discussing it.

But in its technical application to the cheap and effective deposition of gold from its solution, both from the novelty and usefulness of the method it is deemed worthy of your attention.

Preliminary to the description of the process, and necessary to an appreciation of its value in a technical sense, the following facts have an important bearing.

It has been estimated that only about one-tenth of the gold of our country exists in an uncombined state (as free milling ores), or as dust and grains of gold in river sands, or placer washings; such gold is largely obtained by amalgamation processes.

The remaining nine-tenths is found in veins of the older geologic period, and is held in combination by sulphides, arsenides and tellurides; to these ores the process of amalgamation with mercury has been found inapplicable; hence they are generally known as refractory ores.

Two methods have been adopted for working these refractory ores, viz.: Smelting or fusion with lead, and chlorination; that is by first reducing the combined sulphides, &c., to oxides, and then dissolving the gold by means of chlorine.

The process of smelting is applicable to refractory ores only, when they carry a high value in gold, because of the high cost attending the method. Crooks and Röhrig's "Metallurgy" teaches that "ores containing combined gold to the amount at $20 per ton cannot be profitably fused with lead; even could they be raised without mining cost." As a rule in this country this process is not applied on ores below the value of $40 per ton.

By chlorination, ores carrying $20 per ton, can be profitably worked, mining costs included.

Without entering into the question of chlorination, it may be remarked that various methods have been devised whereby the solvent powers of chlorine have been applied to the extraction of gold from such ores. The process is an old one, is one which has been long in use, and the excellence of the method is admitted; it has been found that the solvent power of a chlorine solution is much increased by operating with the gas under a pressure equal to two or more atmospheres.

By such proceeding it is evident that the chlorine solution employed in the chlorinating apparatus will be highly saturated with the gas; it was with such supercharged solutions that the following experiments with carbon were conducted. It is taught that water at ordinary temperatures will

hold in solution two and a half times its volume of chlorine, and that five cubic feet of the gas will weigh one pound, and it has been found in practice that under the Mears' system or method, by pressure, the resultant solution carried such volume of gas as to require an excessive amount of sulphate of iron, or sulphuretted hydrogen (where these precipitants are used) to neutralize the excess of chlorine, before they could act in precipitation of the gold. Thus adding a cost that our low grade ores will not bear; other difficulties and shortcomings, attend the precipitations by these reagents, not necessary to describe, as they are well known to all who have adventured on any of the various modes of chlorination, and which are clearly set forth in Crook and Röhrig's "Metallurgy," in describing Plattner's Chlorinating works at Richenstein, upper Silesia.

From the unsatisfactory results of thus precipitating the gold after it is obtained in solution, chlorination processes have been of limited application, being mainly confined to operations on a small scale and to the concentrated tailings of other processes.

In the effort to overcome these obstacles to success, and to adapt chlorination to the requirements of enlarged operations, the writer reached results which are herein described and explained.

In an aqueous terchloride, or normal solution of chloride of gold, very many substances, both inorganic and organic, will decompose the salt and precipitate the gold in a metallic state, or in combination with the substances employed; but excepting the proto-sulphate of iron, or sulphuretted hydrogen, they are quite inapplicable in a solution surcharged with chlorine, especially is this the case, in the use of organic substances, owing in a measure to their rapid decomposition and disintegration by chlorine.

In vegetable charcoal we find an organic structure capable of resisting the destructive influences of chlorine, therefore, after numerous failures with other organic substances, this was adopted as subject of experiment; and it was found possessed of a remarkable power in decomposing the auric solution, converting the chlorine rapidly into ClH, depositing the gold upon, and throughout the charcoal, and allowing contained copper to pass off in the escaping fluid. Thus, by a simple regulated flow through charcoal, surmounting the sole difficulty to the employment of the chlorine process, on an extended scale of operations.

The gold was retained in metallic form, and of great purity; by long continued action the gold was observed to replace the wasting carbon, atom for atom, fibre for fibre, retaining the form and structure of the fragment of coal, so that on the dissipation of the carbon by incineration, and washing away the ash by SO^3, a brilliant and perfect golden pseudomorph of the coal was obtained.

The copper in the solution was not affected by the coal, and it passed to its appropiate tank to be precipitated by iron as cement copper.

In a report made by Prof. F. M. Endlich, to parties in New York, he says, "In order to test the efficacy of the process, I took, systematically,

samples from the receiving tanks, from the collecting tanks, from the pipe which carried the solution to the filter, and from the stop cock through which the liquid passed after the solution had been in contact with the charcoal.

"The unvarying results of these repeated tests may be summed up briefly:

"While I never failed to get copious precipitates of gold from the solution in the tanks, and from that taken from the faucet through which it flowed into the filter, I never obtained the slightest gold precipitate from *the same liquid after it had passed through the charcoal.*

"The tests which were employed to detect gold in the liquid which had passed through the charcoal were varied, and entirely sufficient to be convincing. Sulphate of iron will decidedly indicate the presence of one part of gold to forty thousand parts of liquid.

"Neither with this reagent, nor with any others that were used could a trace of gold be detected in the liquid taken from the lower spigot of the first barrel, containing one hundred pounds of charcoal, measuring twenty-eight inches vertically, after about nine hundred and sixty gallons of terchloride solution had passed through it."

This amount of solution represented about six thousand pounds of ore, carrying according to assays, $72 in gold.

He continues, "Briefly restating what has been said at greater length, I would repeat that the charcoal filter as here used, is entirely sufficient to precipitate from a terchloride solution, *all the gold* contained therein."

Prof. Endlich remarked on the disappearance of the chlorine from the solution after it had passed the filter. At this stage of the experiment the true cause of the deposition of the gold was not determined, on this point he writes:

"As to the chemical exchanges which take place, and produce the result, I cannot speak positively, and have not, at present, the time at my command to make the requisite investigations."*

It was not until operations were conducted on an enlarged scale that we arrived at an explanation of the reactions which occur in the contact of the terchloride solution with carbon.

It was known to a few antiquarian delvers in chemical records, that among the multitude of substances which decompose a solution of chloride of gold, carbon was named by Count Rumford as possessing this property, but it was only under certain conditions that he observed it to act, for he says, "recently ignited charcoal separates gold, only in sunshine or at 100°;" further experiment proved that under the influence of light, or heat, gold will separate from its solution in the absence of charcoal.

Thus Kane teaches that, "when chlorine water is exposed to the light, it is gradually decomposed, chloride of hydrogen being formed, and

*Prof. E. subsequently writes: "Your conclusions regarding the decomposition of water for the formation of ClH seem a little forced."

oxygen being set free, he further states that heat has the effect of decomposing such solution with the same results;" should gold be present, it will be precipitated in proportion to the disappearance of free chlorine.*

When it thus appeared that the recited conditions alone were sufficient for the deposition of gold from its solution, then was Rumford's discovery consigned to the limbus of useless speculations. This remarkable property of carbon is casually mentioned by a few authors; but it is nowhere taught that carbon is distinguished by any remarkable energy, or as differing from the crowd of organic substances with which it was classed.

Neither is it anywhere suggested that such deposition was of any commercial value, and no use has ever before been made in the metallurgic separation of gold from its solution, nor has carbon been employed in obtaining gold from its ores except as a fuel.

Just the opposite has been the case, for when the attention of experts was called to the claims of this process, they generally agreed that there was nothing in chemical laws or scientific principles to sustain the assumption, and at this moment well informed minds are at a loss to account for the remarkable energy of this new agent in reducing gold from a solution to a metallic state, and the additional fact, that it is inert towards other earthy and metallic constituents of the solution. Thus serving as a refining agent also.

As sustaining the claim of *novelty*, for the hypothesis of the conversion of chlorine into ClH, by carbon, allusion may be made to the contrary opinion of many chemists, as expressed in correspondence with the writer. Several incline to the opinion that the reduction is simply a mechanical attraction of the carbon for the gold (corresponding to the action of animal carbon on the impurities in sugar); this opinion has been held regardless of the disappearance of large volumes of chlorine, and the formation of its equivalent of ClH.

Others ascribe the action to the defective carbonization of the wood, and seek explanation in the "oils, resins, or partially changed wood fibre," which are known to precipitate gold.

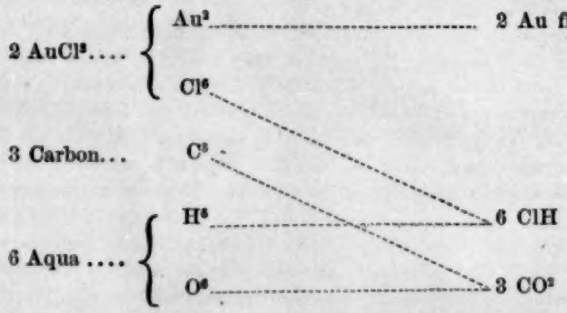
Some claim that the action is due to the presence of hydrogen in the gaseous ammonia, which charcoal absorbs with avidity from the air. If such were the case, the action would be of short duration in the presence of highly charged chlorine solutions; but, that such is not the case, may be experimentally shown, by submitting a perfectly prepared piece of charcoal to a high heat, and, while in a state of ignition, quenching it in distilled water (simply for the purpose of cooling), then immediately transfer it in the dark to a cold surcharged chlorine solution carrying gold and copper; the effect will be the disappearance of the free chlorine, the

* In the quantitative investigation of this subject by Dr. G. A. Kœnig of the Pennsylvania University, as published in Journal of Franklin Institute, May 8, 1882, this property of heat, to decompose a gold solution was overlooked, and his conclusions are invalidated by his employing heat in the digestion of the carbon in the gold solution.

presence of its due equivalent of ClH, the deposition of the gold on the carbon, while the copper will be found in the solution. That the action of carbon in effecting such changes is not evanescent has been shown, but may be repeated in brief:

A filter containing one hundred and sixty pounds of charcoal in the operations of the mill, after a continuous flow of chlorine solution for ten days, and passing sixteen thousand gallons (representing eighty tons of ore) was still effective in producing the above results. Some few writers in their hasty experiments failed in getting satisfactory results and dismissed the subject as "the wild dream of a mad inventor."

The following formula is offered as explanatory of the reactions attending the deposition of gold from its solution by charcoal:



Chemistry teaches that "Chlorine has a powerful affinity for hydrogen, and when brought in contact with other bodies, in the presence of water, will decompose the water by combining with the hydrogen forming ClH and liberating oxygen. Thus, substances are frequently oxidized by chlorine to a higher degree than by nitric acid. Kane teaches that

"Selenious acid (SeO^2) and chlorine in the presence of water is converted into selenic acid (SeO^3) and hydrochloric acid (ClH).

$$SeO^2 + Cl + HO = SeO^3 + ClH."$$

Reasoning from analogy, we may explain the reactions in the deposition of gold: by substituting carbon for selenious acid in this formula; in which case the carbon is oxidized at the expense of the water, the hydrogen uniting with the chlorine to form ClH.

That such are the reactions may be assumed, *a priori*, as all the elements involved are satisfied according to their equivalent affinities, and form definite compounds, leaving the gold free; and it follows, that the deposition of the gold is occasioned by the conversion of the chlorine (which is a solvent of the metal) into chlorohydric acid (in which gold is insoluble), and it is in nowise owing to an attraction or affinity of carbon for gold.

As copper is soluble in muriatic acid it is not affected by the change in

the condition of the chlorine, from a free to a combined state, and this metal remains in solution, as does every contained substance, which is soluble in ClH.

That the free chlorine is thus converted into the combined state is shown by the following experiment, which was made after the carbon had converted two hundred times its volume of chlorine, or the filter of 80 gallons of coal had received 8750 gallons of the chlorine solution, carrying about twice its volume of gas :

Of the running solution two samples were taken, one from the surface before it entered the coal, the other from the bottom after it had passed through the filter; from the first, the chlorine acted powerfully on the senses; in the second, no odor was perceptible.

To equal portions of the two samples were added nitrate of silver, the precipitated chloride was collected, washed and dried with due precautions, and the weights of the two precipitates exactly corresponded; the one measuring the sensible, the other the combined chlorine.

In only one experiment of long-continued action, has a sensible diminution of the carbon been observed; further and more exact determinations than could be made in a mine laboratory are required to establish this point.

Neither has it been determined to what extent the deposit of gold can be carried by this method, the button of gold now exhibited weighing eighteen and a half pennyweights was recovered from the ash of two ounces of charcoal; the filter from which it was taken seemed to have lost none of its activity. The grains from the surface of this filter yielded the pseudomorphs of gold which are before you, and the weight of the gold is above one-third the weight of carbon, which has been removed.

As affecting this question, and possibly of interest to the chemist, the following observation was made on the action of dilute SO^3 on charcoal taken from a filter after being subjected to the action of chlorine for six days :

With the thought that washing this carbon with dilute SO^3 might clean the coal and increase its activity, a portion of it was placed in a glass percolating tube, and the above acid passed slowly through it. The solution from the bottom came away of a dark brown color, but retaining its transparency; on passing this through filtering paper no deposit was retained, showing that the color was not owing to dust of the coal. The solvent action of the acid continued as long as it was applied, and until the size of the carbon grains were sensibly diminished, when the acid solution was replaced by a current of cold water. Now the escaping fluid was almost black, being many shades darker than the acid solution. This when largely diluted was of a rich brown color, and perfectly transparent. The carbon grains were rapidly diminishing in size, and seemingly entirely soluble, when the process was interrupted to test the power of the remaining contents of the tube on an auric chlorine solution.

On passing such solution through the residuum, it was found to have

lost all power in converting the chlorine or depositing the gold. Although the coal in the large filter from which this portion was taken, retained its full power for three succeeding days, and, so far as the eye could judge its character as a charcoal, remained unchanged; whilst the portion subjected to SO^3 had lost all characteristics of charcoal in qualities and appearance. Pressing occupations interfered with a further examination of this method of reducing charcoal to a soluble condition. This is presented as a new and interesting feature in the history of chlorine.

From notes of a laboratory experiment in a qualitative examination, the following details are given as illustrative of the methods employed to arrive at reliable results. The novelty of the subject and the importance of the conclusions, are offered as apology for the minuteness of detail:

A glass percolator, 18 inches deep, was filled with granular wood charcoal, without other preparation than expelling enclosed gases, and removing adhering substances by immersion in water; a gum tube and compressor at the outlet served to regulate the flow; twenty-four ounces of coal were employed; 100 gallons of solution were used, carrying chlorine that was evident to the senses in escaping fumes; inhalation could not be made at the surface of the coal. This represented 750 pounds of an ore assaying $15.65 gold to the ton. Temperature of the room about 75° F., density of the liquid 3.75 Beaumé; the rate of flow was regulated to one gallon per hour, and continued uninterrupted until the close of the experiment, or 100 hours.

At intervals of an hour samples of the escaping fluid were taken, and tested for gold with sulphate of iron, in every instance it failed to detect gold.

The rich blue color of the escaping liquid showed the presence of copper; remembering that the presence of copper had hitherto impaired the action of sulphate of iron as a precipitant, it remained to be shown that the want of precipitate in the test tubes was a reliable indication of the absence of gold; to test this, every tenth gallon of the filtrate was subjected to the following treatment:

The copper was precipitated by clean iron wire, the resulting cement copper washed on a filter, then dissolved by SO^3, and the undissolved portions secured on a filter, dried, and incinerated, and the ash assayed for gold; the return of which was .01 grain. Now as one gallon represented the $\frac{1}{750}$ part of a ton of ore, the above result shows a loss by reason of the presence of copper of 2.66 grains of gold per ton = 11½ cts.

At the conclusion of the flow, the charcoal was washed, carefully incinerated in an iron dish, and the ash smelted with borax. The button of gold weighed 139 grains, as the return from 750 lbs. of ore; which is equal to 371 grs. @ 4¼ cts.....$15.77 per ton.

Assay value of the ore ..... 15.65 " "

A difference of 12 cents per ton in favor of the finer determinations of analysis by solution, over the approximative method of smelting by fire assay.

Working on a larger scale, the following result was arrived at, in the chlorination works near Salisbury, N. C.:

1963 tons worked; average assay	$6.11	=	$11,994.19
Net returns fron U. S. Mint	gold	=	11,158.82
			$835.37

Which shows a loss in working equal 43 cents per ton.

By careful and constant assays of the spent sands, this loss is accounted for, by the washing in the leaching tanks being arrested before the last traces of gold were removed. To thoroughly wash these sands would require a large volume of water, and the loss is regarded as an economic waste.

On this point Dr. Jno. F. Boynton, in a report on an experimental test of the process, reports:

"The spent ores, or tailings, as found in the leaching vats after washing, were subjected to rigid examination; samples were taken of each charge, and careful fire assays made, and in no case did an ounce assay afford gold equal to the one-thousandth part of a grain."

Without entering into the technical details or the costs of manipulation, the above results are presented as evidence that the refractory ores of gold may be worked on an enlarged scale by the joint chlorine and carbon processes, and may in the end utilize the vast stores of these ores, which lie useless in our Southern and Western gold fields.

Stated Meeting, May 4, 1883.

Present, 13 members.

President, Mr. FRALEY, in the Chair.

Letters accepting membership were received from Prof. Heilprin, dated Academy Natural Sciences, Philadelphia, April 4; Mr. A. E. Lehman, dated 907 Walnut street, Philadelphia, April 30, 1883; Mr. Philip C. Garrett, dated Fairfield, Germantown, Philadelphia, May 3, 1883, and Mr. Dillwyn Parrish, dated Philadelphia, May 5, 1883.

Letters of acknowledgment were received from the Verein für Erdkunde, at Dresden (108); and the Accademia dei Lincei at Rome (109, 110, 111).

Letters of envoy were received from the Geological Survey of India, Calcutta, Nov. 3, 1882; the Royal Saxon Society, Dec. 11, 1882; the Royal Leop. Car. Deutschen Akademie, Halle, Dec. 7, 1882; the Royal Akademie der Wiss. at Vienna, Dec. 21, 1882; and the Société d'Agriculture at Lyons, (1 to 109), requesting lacking numbers of the Proceedings, which, however, this Society can no longer supply, their edition being exhausted, viz., Nos. 5, 17, 21, 23, 26, 29, 30, 31, 34, 63 and 64.

A letter requesting exchange of publications was received from the Cincinnati Society of Natural History, 108 Broadway, Cincinnati, April 27. On motion it was placed on the list of corresponding societies to receive the Proceedings.

Donations for the Library were received from the Academies at Halle an d. S., Vienna, Buda-Pest, Dijon, and Brussels; the Societies at Görlitz, Göttingen and Lyons; the Royal Saxon and Jablonowski Societies at Leipsig; the German Apothecaries' Union at Halle; the Royal Lombard Institute; the Musée Guimet; the Ethnographical Institute, Zoölogical Society, Geographical Society, Polytechnic School, Mining Bureau and N. H. Museum at Paris; the Com. Geographical Society at Bordeaux; the Revista Euskara; the Royal Astronomical and Asiatic Societies, Society of Arts, and London Nature; Mr. C. Piazzi Smyth of Edinburgh; Mr. Ed. C. Pickering of Boston; the American Antiquarian Society; American Journal of Science; New York Academy of Sciences; Dr. Daniel Draper; Mr. Thomas Dudley; the Franklin Institute, Numismatic and Antiquarian Society, and Mr. Henry Phillips, Jr., of Philadelphia; the American Chemical Journal and American Journal of Mathematics; United States Naval Observatory; United States National Museum; Bureau of Education; Cincinnati Society of Natural History; Davenport Academy; Mr. Horatio Hale; and the Mexican National Museum.

Mr. Henry Phillips, Jr., communicated "A brief account of the more important collections of American Archæology in the United States."

Dr. Frazer read extracts from a letter from M. Daubrée of Paris requesting information on the subject of subterranean waters in the United States; and from his correspondence with Mr. Selwyn of Montreal, Prof. Fontaine and Prof. Winchell, endorsing his views of the prepalæozoic age of the South Valley hill rock.

Pending nominations Nos. 985, 986, were read.

The Treasurer was authorized to receive City Loan maturing July 1, 1883, and the meeting was adjourned.

A Brief Account of the more important Public Collections of American Archæology in the United States. By Henry Phillips, Jr.

(*Read before the American Philosophical Society, May 4, 1883.*)

To the student of American Archæology it is a matter of the greatest importance to know where in his own land there can be found public collections that will show him the advances made in the arts of war and peace by the aboriginal inhabitants of this Continent. In Europe there exist several of such exhibitions which are noteworthy and famous, where prehistoric America can be studied with great fullness of detail; in the United States there also are rich and valuable public cabinets of American archæology, laboriously and carefully got together, offering a vast field to the seeker after Truth. As to *private* collections, their name is Legion. With a view to diffusing a more general acquaintance with these collections, I prepared a series of queries which I transmitted to every public institution where I had reason to believe there existed such a cabinet, and from the answers received, I have framed the following short account, bringing together matter never before presented at one view.*

ACADEMY OF NATURAL SCIENCES, *of Philadelphia.*

There are five collections of American Archæology at present in the custody of this museum, which, with the exception of the Haldeman collection of arrow-points, stone axes, celts, banner stones, &c., are arranged geographically, and the locality given where each specimen was found. The col-

*No notice has been taken in the following pages of any matter which may relate to collections of *foreign* archæology in the United States; it simply mentions the *American* portion of the cabinets.

lections, having lately been placed in another apartment, are in process of rearrangement, which is taking place under the care of Mr. H. T. Cresson, a well-known and careful student of American archæology.

The collections are as follows:

1. The Poinsett collection of Mexican antiquities, the property of the American Philosophical Society, and deposited by it in the custody of the Academy. It numbers about 2800 specimens, consisting of terra-cottas, objects of obsidian, gold and silver, beads, sculptures, manuscripts, &c., &c. This very fine collection is unique in the United States.

2. The Haldeman collection (about 10,000 specimens), presented by Prof. S. S. Haldeman and wife, in 1879.

3. The Ruschenberger collection of ancient Peruvian pottery (about 200 specimens), presented by Dr. W. W. Ruschenberger, formerly President of the Academy.

4. The Peale collection (about 1800 specimens), formed by Franklin Peale, Esq., and presented to the Academy by his widow.

5. The Vaux collection (about 900 specimens), bequeathed by Wm. S. Vaux, Esq., in 1882.

The especial features are the pottery in the Ruschenberger, Poinsett and Haldeman collections; the valuable and important Poinsett collection as a whole; and a large collection of axes (stone), arrow-points, &c., embracing many rare forms, from all parts of the United States.

American Philosophical Society, *Philadelphia.*

The valuable collections of this Society are deposited with the Academy of Natural Sciences in Philadelphia, and displayed with its cabinets.

Archæological Institute of America, *Boston, Mass.*

This institution "deposits its collections in existing institutions."

American Antiquarian Society, *Worcester, Mass.*

This cabinet was founded in 1812. Its collections, which although not numerous are valuable, consist of stone implements and mound relics, whose number has not been furnished. It is only partially arranged, catalogued and labeled, and the localities where the specimens were found are not always given.

Amherst College, *Amherst, Mass.*

This collection is about forty years old, and is mainly comprised of specimens found in the valley of the Connecticut river, within fifty miles of the town. The best specimens, some twenty-five hundred, are entered in the catalogue, an outline of each one being drawn. They are properly labeled, and the locality given where each was found. The especial features of the collection are samples of all the pottery supposed to be of New England aboriginal manufacture. It is also rich in Indian pipes.

BROWN UNIVERSITY, *Providence, R. I.*

This cabinet was begun in 1872. The specimens, which are numerous but whose exact number is not known, are arranged for the present typically. In most cases they are labeled with the name of the place where found.

DAVENPORT ACADEMY OF NATURAL SCIENCES, *Davenport, Iowa.*

This cabinet was formed during the last ten years from finds in the vicinity of fifty miles of the city. The pottery is mostly from the mounds of the Lower Mississippi valley; the shell ornaments and bone implements are also mainly from thence; the stone and flint implements from Wisconsin to the Gulf of Mexico, and from Florida to Colorado. It is classified chiefly typically. It possesses inscribed tablets found at Davenport, carved stone pipes, typical of the Upper Mississippi, *i. e.* of the "curved base" pattern, of which there are 57. This is the largest collection of this type in the United States.

Of other patterns of prehistoric pipes there are	30
Hammered copper axes	28
" " awls	16
" " beads	300
" " knives, &c	5

Prehistoric pottery vessels over 1000, some of them the largest ever found in North America:

Flint implements over	10,000
Stone " "	1000
Hæmatite " "	52
Obsidian points	25
Shell and pearl beads several hundred.	
Gorgets and other shell ornaments	70
Bone implements mostly awls	120

Perforated ceremonial stones, &c., 21; skulls of northern mound-builders, 35; skulls of southern mound-builders, 33; skulls of Sioux Indians, 307; skulls of Central American, 127, &c.

The collection which is in process of catalogueing, is displayed in glass cases in such a manner as to be readily accessible.

The localities are given in the labels, together with many other details, "so that the whole explains itself to the visitor" writes Mr. W. H. Pratt, who kindly furnished the data for the foregoing account.

GEORGIA HISTORICAL SOCIETY, *Savannah, Ga.*

The collections of this Society were begun in 1839, but, not being very extensive, are not arranged in a strictly scientific manner. The specimens which are labeled, and on exhibition in the Society's Hall, are not catalogued.

METROPOLITAN MUSEUM OF ART, *New York City, N. Y.*

This collection (which is not large) consists of Mexican, Peruvian and Central American antiquities, and of mound-builder's pottery, all acquired since 1880, and numbers about 200 pieces. It is classified geographically. Among the noteworthy features of the collection are a remarkable Aztec pot and some pieces of Peruvian metal work. The Mexican terra-cottas are also worthy of remark. A catalogue is now in press in which the localities are given of each specimen so far as known.

MAYSVILLE AND MASON COUNTY HISTORICAL AND SCIENTIFIC ASSOCIATION, *Maysville, Ky.*

The collections of this Society were begun in 1875, their object being to illustrate the various implements used by the mound-builders of the Ohio Valley. The specimens were mostly found within a radius of fifteen miles of the town. The collections are not fully catalogued and arranged, but among the more noteworthy are a hæmatite skin-dresser, one leaden implement, two inscribed stones, eight discoidal stones, five boat-shaped stone images, twenty-two stone maize-beaters, thirty-two ground-stone hatchets, one stone image of a sheep or llama (head and half the body), ninety-two skin-dressers, sixty-two hammer-stones, six chert-choppers, two flint-choppers, three flint (burial) stones, seventeen slate ceremonial implements, two and one-half round sinkers, eleven stone sinkers, one stone plummet, two stone chisels, one stone roller, fifty-two flint drills, six hundred arrow and spear-points, eighty-seven war arrow-points, seventy flint knives, sixty-five scrapers, thirteen flint skin-dressers, one flint gouge.

MINNESOTA HISTORICAL SOCIETY, *St. Paul, Minn.*

The fine museum of this Society was destroyed by the fire of March 1, 1881. It now only possesses two stone hammers and a copper chisel.

MISSOURI HISTORICAL SOCIETY, *St. Louis, Mo.*

The collections of this Society are as yet in their infancy, and not catalogued and arranged.

NEW LONDON COUNTY HISTORICAL SOCIETY, *New London, Conn.*

This collection being of recent origin, has not yet been entirely arranged, classified, labeled, and catalogued. The specimens number about 2500.

THE NATIONAL MUSEUM, *Washington, D. C.*

This collection was established in 1842, its possessions then consisting of the specimens obtained during the Wilkes' Exploring Expedition. In 1858 it passed into the care of the Smithsonian Institution. The general collection is arranged typically; special collections from mounds, shell-heaps, &c., are kept together. At present it contains about 20,000 chipped implements, arrow-heads, &c.; about 3000 hammer stones, celts, pestles,

grooved axes, pipes, ornaments, &c.; about 800 objects of shell, beads, &c.; about 600 bronze implements and ornaments; about 600 shell-heap remains; about 700 mound remains; and about 300 cave remains. It is catalogued and the locality given where each specimen was found. "It is considered the largest existing collection of *North American* antiquities," writes Professor Baird. The display is made in sixty-two glass cases, in a hall 200 feet long by 50 wide.

PEABODY MUSEUM OF AMERICAN ARCHÆOLOGY AND ETHNOLOGY, *Cambridge, Mass.*

The Museum was founded by the gift of $160,000 by Mr. George Peabody, in 1866.

The Museum has made a number of special explorations from which large returns have come, among which may be mentioned the exploration by Prof. Hartt in Brazil, those by Dr. Flint in Central America, and the many special explorations in North America, including those of Dr. Palmer in various parts of Mexico, and among the Indians of the Southwest; of Miss Fletcher among the Indians of the West; of the late Dr. J. Wyman (the first curator) in Florida and along the Atlantic coast, of Dr. Schumacher on the coast of California; Mr. H. Gilman in Michigan, of Prof. Andrews in Ohio, Mr. Dunning in Tennessee, Dr. Abbott in New Jersey, Dr. Metz in Ohio, Mr. Curtis in Tennessee and Arkansas, and the explorations of Prof. Putnam in various parts of the country, particularly of New England shell-heaps, of mounds and ancient burial places in the Western and Southwestern States, of caves in Kentucky, etc., etc.

"The Museum" writes Prof. F. W. Putnam, its curator, "contains by far the most important collections in existence relating to the archæology of America as a whole. (In ethnological material it is not so well off, but it contains pretty large collections of that.) The arrangement of the collections is based upon a geographical distribution of the materials in the several exhibition halls, but it is made to embrace an ethnological and archæological presentation of the subject. Every specimen in the Museum (over 300,000) is catalogued and numbered, and unless the exact locality and conditions under which a specimen was found is known, it is considered as worthless for exhibition, and of no value to an archæological or ethnological series."

PEABODY ACADEMY OF SCIENCE, *Salem, Mass.*

This collection is composed of those of the East India Marine Society (begun in 1799), and of the Essex Institute (1826), which in 1867 were permanently placed in the East India Marine Hall, purchased and refitted by the Trustees of the Peabody Academy of Science in that year.

The Department of American Archæology contains 2390 catalogue numbers, in all about 5500 specimens; axes, 100; celts, 150; gouges, 150; club-heads, 50; hammer-stones, 50; long stones (pestles), 100; discs, 10; spear-points, 500; arrow-points, 2000; scrapers, 200; bones

from shell-heaps, a half bushel; bone implements, 50; grave contents, 25 skulls, and long bones and numerous implements, shell beads, &c.; copper implements, 2; soapstone pots, 3; broken pottery (soapstone), 50; clay pots, 5; broken clay pottery, 500; core stones and rude implements, 500; chips, a bushel; mortars and mills, 6; ceremonical objects, 50; shoes, &c., (salt cave, Kentucky,) 20; implements showing contact with European civilization, 50; bone spoons from graves, 4; knives, of various shapes; piercing tools, 10. The bulk of the collection is from the Eastern portion of the United States, very few being from south of Pennsylvania or west of New York State. They are arranged by types according to the order of Abbott's primitive industry, and the special features of the collection are the specimens figured in that work. All are labeled. The "archæology of Essex County, Mass.," is arranged separately, and made an especial feature of the Museum. It is in a case seven feet high and forty feet long. Independent of the usual assortment of axes, celts, gouges, &c.; it contains one very fine skeleton intact from a reburial at Marblehead, Mass., and a number of grave contents, such as beads, wampum and bones, &c.: also articles from shell-heaps, and the entire valuable contents of one shell-heap opened in 1882. The general appearance of these implements is rude as compared with those from the Western States, and the finds are but scanty in comparison.

Especial attention is called to the manner in which the specimens are fastened, so that placed in upright cases, every kind of article may be placed. Bent headless pins are used to clamp the objects on black tablets which are placed on easels and in the cases.

"The Museum is one of the first-class," writes Mr. John Robinson, Treasurer and temporary Curator, who has kindly furnished the data for the foregoing account.

PHILADELPHIA. THE NUMISMATIC AND ANTIQUARIAN SOCIETY OF

This collection was begun in January, 1858. It is at present undergoing rearrangement and classification, by Mr. Edwin A. Barber, Curator of Antiquities, so that no exact details can be given, but it is believed that by the end of the present year it will be in perfect order; before which time also the Society expects to receive some remarkable American antiquities, almost unique in this country.

PENNSYLVANIA MUSEUM AND SCHOOL OF INDUSTRIAL ART, *Memorial Hall, Fairmount Park, Philadelphia.*

This institution possesses a small but valuable collection of Peruvian, Pueblo and other American pottery. A large collection of American archæology at present on exhibition will probably shortly be removed on account of the death of the owner.

POLYTECHNIC SOCIETY, *of Louisville, Kentucky.*

This Society "possesses some rare and valuable archæological specimens," but they are neither catalogued, classified nor arranged. "Among the more important," writes Mr. E. A. Grant, "is a copper spool found in a mound, much oxidized, but still having the remains of fibrous cord imbedded in the copper, so that the same can be removed."

RHODE ISLAND HISTORICAL SOCIETY, *Providence, R. I.*

The collection was begun in 1822. It is not at present fully classified; the localities of the specimens are not always given; their number is unknown. Mr. Perry, the Secretary of the Society, writes, "Our Indian relics need a thorough overhauling."

TENNESSEE HISTORICAL SOCIETY, *Nashville, Tenn.*

In its cabinets are many objects of American archæology (number not given), including Pueblo manufactures, stone images, arrow-heads, fleshers, discs, &c., &c. Some are on exhibition in the State Capitol, and the Society expects to soon occupy a new hall, where its large and valuable collection will be properly arranged and displayed.

UNIVERSITY OF MICHIGAN, *Ann Arbor, Michigan.*

This collection has "never been classified or catalogued. It is in process of removal to a special room where it will be arranged geographically." The number of its specimens is not known. Among the most noticeable are Peruvian pottery, and Alaskan implements, &c.

WISCONSIN NATURAL HISTORY SOCIETY, *Milwaukee, Wis.*

This collection has not yet been fully classified nor catalogued, nor are the specimens all labeled, but it is expected that before long it will be properly arranged and put in complete order. "It contains" writes Mr. Carl Dœrflinger, the Secretary and Custodian, "some 2500 specimens, including 300 arrow-heads, 100 stone hammers, axes, &c., 20 copper implements, among which latter are some interesting forms."

They are displayed in table and wall-cases.

WISCONSIN HISTORICAL SOCIETY, *Madison, Wis.*

The collection (which is a large and valuable one) was all found within the limits of Wisconsin and mainly in the southern part of the State. It is arranged typically and all specimens are marked with the localities whence obtained. A catalogue exists in manuscript.

In 1876 the number was as follows: *Copper* implements, spears, knives and tomahawks, 109; stone rollers, pestles, scrapers, knives, awls, &c.

600; stone axes (one weighing 8½ lbs.) 365; stone pipes and perforated ornaments, about 250; and over 8000 spear—lance—and arrow-heads.

The collection has been largely increased since 1876. "The especial feature of the collection" (writes Mr. I. S. Bradley, of Madison) "is the great number of large and well made *copper* implements, and some remarkably fine stone axes."

The collection is displayed in horizontal glass cases.

WYOMING HISTORICAL AND GEOLOGICAL SOCIETY, *Wilkes-Barre, Pa.*

"This cabinet originated in the year 1858, the date of the foundation of the Society. The collection is in the main made up of local finds, a few specimens being from other places at a distance; it may, however, be considered as a distinctively local collection. It is classified typically, and consists of specimens as follows:

Pottery: 5 specimens as shown in publication No. 4, also 2 specimens of such size as to show the shape, size and design of vessel, and about one-half a bushel of fragments collected for pupose of studying material used in their manufacture, ornamentation, &c.

Net sinkers, 125; *hoes*, 5; *hand-hammers* or *hammer-stones*, 41; *rubbing-stones*, 5; *discoidal stones*, 10; *ceremonial objects*, perforated, 5 as shown on page 352 of Abbott's "Primitive Industry," 2 such as shown on page 356, and 1 as on page 359, and several fragments of same; *totems, gorgets, &c.*, 25, *and fragments; beads*, 5 strings; *pipes*, 15; *celts, skinners and chisels*, 60; and 15 broken specimens; *tomahawks*, 11; *ground-stone axes*, 22; *ground-stone club heads* or *death mauls*, 17; *mortars, stone*, 3; *lignumvitæ* 1; *shallow mortars or lap-stones*, 5, 2 of them bi-concave; *crushers*, 4; *pestles*, 20 perfect, and 14 broken; *plummets*, 3; *engraved stone*, 1; *plows*, 2 ("I have never seen these implements described, and call them plows at a venture;" writes Mr. Sheldon Reynolds, the Curator of the Society, who has kindly furnished the description of the collection), they are about 18 inches long, 4 inches square at one end, retaining the square throughout nearly half their length, they are then rounded and the balance is in shape of a tapering pestle, weighing about 15 or 20 pounds.

Stone last, 1: (Roughly chipped stone bearing close resemblance to a last, and supposed to have been used for that purpose).

Pitted stones, 2: Supposed to have been used for mixing colors in.

Pulæolithic instruments, 4.

1 *large flat stone*, evidently used for smoothing (dressing) skins, found covering Indian grave.

Arrow-points, 2400.

Spear-points, 150.

1 *copper spear-point*, found in mound in neighborhood.

3 *crania;* 3 *bows;* 2 *quivers;* 1 *canoe;* 2 *belts wampum.*

The collection is believed to represent in a fair degree generally the articles of ornament, domestic utensils, and weapons of the chase and warfare of the aborigines.

It is displayed in glass-covered table cases; each object bearing a number and the name of the person who gave it; when practicable the number refers to a manuscript descriptive catalogue.

It is catalogued with the other collections of the Society. A separate catalogue of each department is about to be begun.

The localities are given where each specimen was found.

"The stone last is believed to be unique, and perhaps the plows. The engraved stone is an object of interest as representing growing plants, resembling tobacco and corn; the stone is broken, of irregular shape, and about three inches square. (?) Among the arrow-points are some stained a light purple; the coloring extends one-half the length. No analysis of the coloring matter has been made. These arrows are very diminutive, some not more than three-quarters of an inch over all; others somewhat larger. They were found on the flats opposite the city of Wilkes-Barre. Arrow-points of this size are said to be of rare occurrence east of the Allegheny mountains."

NOTE.—The following list embraces the names of Institutions to which letters of inquiry were sent upon information that they were in the possession of collections of specimens of American archæology, but from which no responses have been received.

Academy of Natural Sciences, Baltimore, Md.
Academy of Natural Sciences, San Francisco, Cal.
American Museum of Natural History, New York, N. Y.
Boston Society of Natural History, Boston, Mass.
Bristol (town of), Bristol, R. I.
Bronson Library, Waterbury, Conn.
Brook's Museum, University of Virginia, Va.
Cincinnati Historical and Philosophical Society, Cincinnati, Ohio.
Firelands Historical Society, Norwalk, Ohio.
Franklin Society, Providence, R. I.
Kentucky State Geological Survey, Frankfort, Ky.
Long Island Historical Society, Brooklyn, N. Y.
Macon Public Library, Macon, Ga.
Madisonville Natural History Society, Madisonville, Ohio.
Maine Historical Society, Portland, Me.
Middlebury Historical Society, Middlebury, Conn.
New Hampshire Antiquarian Society, Contoocook, N. H.
Newport Historical Society, Newport, R. I.
New York Historical Society, New York, N. Y.
Toledo Historical and Geographical Society, Toledo, Ohio.
University of California, San Francisco.
Vineland Historical and Antiquarian Society, Vineland, N. J.
Western Reserve Historical Society, Cleveland, Ohio.
Yale College, New Haven, Conn.
Young Men's Library, Atlanta, Ga.

Photodynamic Notes, VIII. By Pliny Earle Chase, LL.D.

(Read before the American Philosophical Society, May 18, 1883.)

376. *Virials.*

The theory of the virial, or mean *vis viva* during stationary motion, enables us to coördinate all forms of cyclical motion : rotary, orbital and oscillatory. The grandest manifestations of the virial, which are given in cosmical motion, must be governed by the same laws as govern molecular movements. The complete development of the theory should, therefore, remove all the obscurity which still clings to the doctrine of radiodynamic unity. The science of comparative kinetics is greatly indebted to Clausius, for his presentation of the theory, for the consequent simplicity which it introduces into the solution of problems which would otherwise be exceedingly complicated and for the facility of explanation, which it gives for methods which are substantially the same, but which, on account of their novelty, have been often misunderstood.

377. *Virial Postulates.*

My photodynamic and other physical researches have been rewarded by a great number of cosmical illustrations of virial efficiency, which are based upon the following postulates :

1. That cosmical masses represent internal energies, such as would be found if they were condensed from some primitive tenuous, elastic form of matter.
2. That all chemical elements may have been condensed, in like manner, from a single primitive element or æther.
3. That the velocity which enters into the primitive radial virial of the oscillating æthereal particles is the velocity of light (v_λ).
4. That the stationary motions of central inert masses, which represent the equal actions and reactions of primitive and derived virials should continue until the velocity of the primitive virial has been alternately acquired and lost.
5. That all stationary motions which represent equal actions and reactions should be harmonic.

378. *Stellar Virials.*

Solar or Stellar centres of planetary systems are central inert masses (Post. 4), which are endowed with velocities of stationary motion, tending to give velocities of stationary revolution, sending forth æthereal oscillations with the velocity of light (Post. 3) and representing internal energies like those which would spring from nebular condensation (Post. 1). Their central stationary motions should, therefore, be cyclically determined by the alternate acquisition and exhaustion of the radial velocity of light (Post. 4). Herschel (*Outlines of Astronomy*, Sect. 399) discoursed elo-

quently on the Sun's rays as "the ultimate source of almost every motion which takes place on the surface of the earth." We may, therefore, reasonably look to them for evidences of virial efficiency, in various forms, which will furnish satisfactory proof of radiodynamic unity.

379. *Equal Virial Action and Reaction.*

Circular orbital velocity which is due to solar action may be represented by the equation

$$v_n = \sqrt{g_n r_n} \qquad 1.$$

The limiting value of v_n, which it cannot exceed, is found at Sun's surface ($r_\circ$), where $g_\circ$ is a maximum. It may be represented by

$$[v_\circ] = \sqrt{g_\circ r_\circ} \qquad 2.$$

The third and fourth postulates lead to the equation

$$v_\lambda = g_\circ t_\circ \qquad 3.$$

This equation should hold good for all values of r in an expanding or contracting nucleus, inasmuch as g varies inversely as r^2 and the principle of conservation of areas requires that the time of rotation should vary directly as r^2. The product of the two factors should, therefore, be constant.

380. *Numerical Verification.*

Taking Sun's semi-diameter ($r_\circ$) as the unit of length, and the British Nautical Almanac estimate of Sun's apparent semi-diameter (961.″83) as the parallactic unit, we find, for Earth's semi-axis major

$$\rho_3 = 214.45 r_\circ \qquad 4.$$

Earth's mean orbital velocity (1) may be found by dividing $2\pi\rho_3$ by the number of seconds in a year (31558149). This gives

$$v_3 = .0000001990099\rho_3 \qquad 5.$$

This value varies slightly with varying orbital eccentricity. The greatest secular range of variation, however, is less than $\frac{1}{8}$ of one per cent.

Circular orbital velocity varying inversely as the square root of the radius-vector, we find (2), (4), (5)

$$[v_\circ] = .00000291562\rho_3 = .000625253 r_\circ \qquad 6.$$

$$g_\circ = .0000003909445 r_\circ \qquad 7.$$

Struve's constant of aberration gives, by (3) and (7)

$$v_\lambda = g_\circ t_\circ = 214.45 r_\circ \div 497.827 = .430772 r_\circ \qquad 8.$$

$$t_\circ = 1101876 \text{ sec.} = 12.753 \text{ days} \qquad 9.$$

This gives for a double oscillation, or complete rotation of Sun, 25.506 days. Laplace's estimate was 25.5 days. The motion of sun-spots near the equator is accelerated by centrifugal force, tendencies to orbital velocity, "repulsion," or some other unknown influence. Spörer's formula gives 24.62 days for the period at the equator, where no spots have ever been observed. His third estimate, for 1866, was 25.234 days.

381. *Virials of Rotation.*

The rotating æthereal tendency of stationary motion, which is limited

by equations (2) and (3), gives the following value for the limiting radius (ρ_λ) of orbital and æthereal tendencies :

$$\rho_\lambda = \frac{v_\lambda}{[v_\circ]} r_\circ = v_\lambda \sqrt{\frac{r_\circ}{g_\circ}} \qquad 10.$$

Laplace's limit (l) of equal rotary and orbital velocity is given by the equation

$$l = \left(\frac{\rho_\lambda}{\pi r_\circ}\right)^{\frac{1}{2}} r_\circ = \left(\frac{\rho_\lambda}{\pi}\right)^{\frac{1}{2}} r_\circ^{\frac{1}{2}} \qquad 11.$$

The limit at which the equatorial velocity of stationary motion would give $v_\circ$ is

$$\left(\frac{l}{r_\circ}\right)^{\frac{3}{2}} r_\circ = l^{\frac{3}{2}} \div r_\circ^{\frac{1}{2}} = \rho_\lambda \div \pi \qquad 12.$$

The limit at which the equatorial velocity of stationary motion would give v_λ, as deduced from (10) and (12), is

$$[l] = \rho_\lambda^2 \div \pi r_\circ \qquad 13.$$

The limit of a homogeneous, elastic, æthereal atmosphere which would propagate undulations with the velocity of light, is

$$M = \pi [l] = \rho_\lambda^2 \div r_\circ \qquad 14.$$

382. *Virial Centres of Oscillation.*

The virials of rotating tendency must influence grosser inert particles or masses, as well as the æthereal atmosphere. Loci of important oscillatory influence may be found at radii of mean æthereal momentum (ρ_α), of linear oscillation (ρ_β), of reciprocal linear oscillation (ρ_γ), of spherical oscillation (ρ_δ), and of reciprocal spherical oscillation (ρ_ϵ). Taking ρ_λ as the common virial locus of these several oscillating tendencies, we have

$$\rho_\alpha = 2\rho_\lambda \qquad 15.$$
$$\rho_\beta = 1.5\rho_\lambda \qquad 16.$$
$$\rho_\gamma = 3\rho_\lambda \qquad 17.$$
$$\rho_\delta = 2.5\rho_\lambda \qquad 18.$$
$$\rho_\epsilon = \tfrac{1}{3}\rho_\lambda \qquad 19.$$

All of these forms of action and reaction must be called into play by solar and stellar radiation, and they should all be studied in investigating the maintenance of cosmical energy.

383. *Maintained Vibrations.*

Lord Rayleigh (*Phil Mag.*, April, 1883) discusses a vibrating system which is subject to dissipative forces, and the necessity, when the vibrations are maintained, that the vibrating body should be in connection with a source of energy. In the usual equation

$$\frac{d^2\theta}{dt^2} + \frac{d\theta}{dt} + n^2\theta = 0 \qquad 20.$$

two principal classes of maintained vibrations may be distinguished; the more extensive class being that in which the magnitude and phase of the sustaining force depend in an approximately constant manner, upon the amplitude and phase of the vibration itself. The only case in which, according to (20), a steady vibration is possible, is when the complete value of κ is zero. If any portion of the energy of cosmical masses is dissipated, æthereal energy must be proportionately increased. The æther accordingly becomes a "source of energy," and although we are not yet able to see fully how the connection of this source with solar radiations is kept up, the equivalence of v_λ to v_γ (Note 321) shows that it is kept up, through cyclical actions which cover a period of about $12\frac{3}{4}$ days.

384. *Virials of Wave Propagation.*

It has often been tacitly assumed that there is no actual radial oscillation in luminous radiation, like that of the atmospheric particles in the propagation of sound-waves. In 1872 (*Proc. Amer. Phil. Soc.*, xii, 394) I showed that the secondary centre of oscillation, on returning from the centre of linear oscillation towards the linear centre, is at $\frac{4}{5}$ of the extreme excursion. Hence the tangential virial of an oscillating æthereal particle (μ_α), is $\frac{2}{5}$ of the radial virial of the same particle (μ_β). More than five years afterwards (*Phil. Mag.* [5], iii, 453; iv, 209), Maxwell stated that the ratio of the virial velocity is $\sqrt{\frac{2}{5}}$, but he gave no reason for his inference and none has yet been found among his unpublished papers. His statement and mine are substantially identical, the only difference being that he looked to the relative mean momentum of the oscillating particles, while I looked to their relative virials.

$$\mu_\alpha = 1.8\ \mu_\beta \qquad 21.$$

385. *Time-Relations of Inertia.*

The question of instantaneous action is still, and probably will long continue to be, a mooted one. The most impressive form in which it has ever been presented, is Laplace's statement that gravitating action requires a velocity which is more than 100,000,000 times as great as the velocity of light, and that it may be assumed to be absolutely instantaneous at all distances. It is sometimes said that inertia is instantaneously overcome. This may, perhaps, be true in some sense, but we cannot know that it is so, until we know more than we have yet learned about the way in which velocity is transferred from one body to another. In general physical investigations the element of time, usually in the form of time-integrals, requires consideration whenever there is any change of motion.

386. *Correlation of Virials.*

Questions of kinetic unity and correlation are greatly complicated by differences of inertia and by the lack of generally recognized standards of comparison. If all forms of force are transmitted through æthereal intervention, all virials should be capable of representation in terms of æthereal mass and velocity. The velocity of luminous undulation then becomes a

natural standard of velocity. Whenever velocity is imparted or destroyed by gradual accelerations or retardations (f), a time can always be found which will give the equation

$$ft = v_\lambda \qquad 22.$$

By cōordinating the times which are required by this equation in different forms of energy, the evidences of primitive kinetic unity may be multiplied indefinitely.

387. *A Natural Unit of Time.*

Errors of measurement which are of any specific magnitude, increase in relative importance inversely as the magnitude which is measured. An error of .0001 inch in any of the dimensions of a microscopic object would be very serious, but in an object which is a foot or more in length it would be insignificant. It is desirable, therefore, in studying kinetic unity, to begin with phenomena which involve kinetic maxima. The most far-reaching acceleration of which we can make measurements, is that of gravitation, and the greatest gravitating acceleration of which we have any direct knowledge ($g_\circ$) is found at Sun's surface. Substituting in (22) we have

$$ft = g_\circ t_\circ = v_\lambda \qquad 23.$$

Therefore, Laplace's principle of periodicity (Note 333), the collateral hypotheses of various investigators (Note 278), the fourth virial postulate (Note 377), the considerations which make v_λ a natural unit of velocity (Note 383), as well as many other correlations of photodynamic and general cyclical energy, point to the time of solar rotary oscillation as a natural unit of time.

388. *Virial Transfers.*

An energy which is wholly transferred from one æthereal mass to another equivalent æthereal mass, must be accompanied by a like transfer of velocity, whether the transfer is in the form of potential (v_α), work (v_β), gravitation (v_γ), torsion (v_δ), electricity (v_ϵ), rotation (v_ζ), revolution (v_η), heat (v_θ), chemical affinity (v_κ), or luminous undulation (v_λ). We have, therefore, for limiting velocities when all the units are homologous,

$$v_\alpha = v_\beta = v_\gamma = v_\delta = v_\epsilon = v_\zeta = v_\eta = v_\theta = v_\kappa = v_\lambda \qquad 24.$$

In cyclical movements which are due to virial tranfers, these several equivalents may be indicated by equations which are based on the third and fourth postulates (Note 377) and which are analogous to (3).

389. *Cardinal Limits.*

In seeking further numerical verifications of the foregoing virial equations, we find the photodynamic limiting radius of orbital and æthereal tendencies (10) by substituting (6) and (8).

$$\rho_\lambda = 688.954\, r_\circ = 3.212654 \rho_\beta \qquad 25.$$

Substituting (25) in (11), we get for Laplace's limit

$$l = 36.366 r_\circ \qquad 26.$$

The substitution of (25) in (12) gives

$$\rho_\lambda \div \pi = 219.301 r_0 = 1.0226 \rho_3 \qquad 27.$$

Hence by (13), we find for the locus of v_λ in solar rotation,

$$[l] = 151088.1 r_0 = 704.538 \rho_3 \qquad 28.$$

And the solar modulus of light (14) is

$$M = 474657.3\, r_0 = 2213.37\, \rho_3 \qquad 29.$$

390. *Influence of Synchronous Radial and Tangential Virials.*

The theoretical variation of æthereal density within the limits of our planetary system (Note 240) is so slight that the several vector radii may be considered as indicative of virial projection against a resistance which is nearly uniform. The radial and tangential virials (Note 384) being synchronous, we may with reason look for cosmical evidences of the synchronism. Accordingly we find, from (21) and (25), the following regular series of approximations to planetary loci. The subscripts, 1, 2, 3, denote, respectively, secular perihelion, mean, secular aphelion.

$1{\cdot}8^{-4}\ \rho_\lambda$	$= \cdot3060\rho_3$	Mercury_1	$= \cdot2974\rho_3$	30.
$1{\cdot}8^{-3}\ \rho_\lambda$	$= \cdot5509\rho_3$	Venus_1	$= \cdot6722\rho_3$	31.
$1{\cdot}8^{-2}\ \rho_\lambda$	$= \cdot9916\rho_3$	Earth_2	$= 1{\cdot}0000\rho_3$	32.
$1{\cdot}8^{-1}\ \rho_\lambda$	$= 1{\cdot}7848\rho_3$	Mars_3	$= 1{\cdot}7365\rho_3$	33.
$1{\cdot}8^{0}\ \rho_\lambda$	$= 3{\cdot}2127\rho_3$	Asteroid 108	$= 3{\cdot}2120\rho_3$	34.
$1{\cdot}8^{1}\ \rho_\lambda$	$= 5{\cdot}7828\rho_3$	Jupiter_3	$= 5{\cdot}5193\rho_3$	35.
$1{\cdot}8^{2}\ \rho_\lambda$	$= 10{\cdot}4090\rho_3$	Saturn_3	$= 10{\cdot}3433\rho_3$	36.
$1{\cdot}8^{3}\ \rho_\lambda$	$= 18{\cdot}7362\rho_3$	Uranus_2	$= 19{\cdot}1836\rho_3$	37.
$1{\cdot}8^{4}\ \rho_\lambda$	$= 33{\cdot}7252\rho_3$	Neptune_3	$= 30{\cdot}4696\rho_3$	38.
Geom'l Mean	$= 3{\cdot}2127\rho_3$	Geom'l Mean	$= 3{\cdot}2200\rho_3$	39.

All of these approximations represent loci of belt-condensation, for the respective planets, which are in accordance with the nebular hypothesis. The geometrical means differ by less than $\frac{1}{4}$ of one per cent. The photodynamic mean represents the semi-axis major of Asteroid 108; the planetary mean, the semi-axis major of Asteroid 122. The second photodynamic locus ($\cdot5509\rho_3$) is, within less than one per cent., the arithmetical mean between the semi-axes major of Mercury and Venus (·5552).

391. *Photodynamic Centre of Various Oscillations.*

The common virial locus (Note 382) of mean momentum, linear oscillation, spherical oscillation, and reciprocal oscillations, gives the following planetary approximations by (15), (16), (17), (18), (19) and (25):

$\rho_\alpha = 6{\cdot}4253\rho_3$	Cardinal centre	$= 6.4451\rho_3$		40.
$\rho_\beta = 4{\cdot}8190\rho_3$	Jupiter_1	$= 4{\cdot}8863\rho_3$		41.
$\rho_\gamma = 9{\cdot}6380\rho_3$	Saturn_2	$= 9{\cdot}5389\rho_3$		42.
$\rho_\delta = 8{\cdot}0318\rho_3$	.4 Uranus_3	$= 8{\cdot}2717\rho_3$		43.
$\rho_\varepsilon = 5{\cdot}3545\rho_3$	Jupiter_2	$= 5{\cdot}2028\rho_3$		44.
Ar. Mean $= 6{\cdot}8537\rho_3$	Ar. Mean	$= 6{\cdot}8690\rho_3$		45.
Ge. Mean $= 6{\cdot}6325\rho_3$	Ge. Mean	$= 6{\cdot}6421\rho_3$		46.

It will be seen from (43) that the second locus of spherical rotary projection from ρ_λ, ($2{\cdot}5 \times 2{\cdot}5\rho_\lambda = 20{\cdot}0795\rho_3$), is within the secular orbital range of Uranus. The cardinal centre (40) is the centre of gravity, at conjunction, of Saturn$_3$ and Jupiter$_3$. It represents, therefore, the locus of mean rotary momentum for their combined masses, at the time of Jupiter's incipient rupturing subsidence, according to Herschel's modification of the nebular hypothesis.

392. *Further Relations of the Cardinal Centre.*

The cardinal centre, which introduces the series in the foregoing note, also represents important relations to the following additional virial loci:

$\rho_\zeta =$	$\sqrt{\Sigma m\rho^2 \div \Sigma m}$	$= 9.2443\rho_3$	47.
$\rho_\eta =$	$\Sigma m\rho \div \Sigma m$	$= 7{\cdot}5228\rho_3$	48.
$\rho_\theta =$	$\frac{1}{2}$ (Saturn$_3$ + Jupiter$_3$)	$= 7{\cdot}5291\rho_3$	49.
$\rho_\iota =$	$\frac{1}{2}$ (6·4451 + 8·2717)	$= 7{\cdot}3584\rho_3$	50.
$\rho_\kappa =$	$\frac{1}{4}$ Neptune$_3$	$= 7{\cdot}5084\rho_3$	51.

The locus of mean planetary nebular inertia (47) is in Saturn's orbit, where the rings, the satellite system and the specific gravity bear witness to the results of nebular condensation. The locus of mean planetary nebular momentum (48) approximates closely to the arithmetical mean between Saturn$_3$ and Jupiter$_3$ (49), to the arithmetical mean between the cardinal centre and the incipient virial locus of spherical rotation for Uranus (50), and to the virial locus for the mean linear momentum of Neptune's semi-axis major (51).

393. *Primitive Virial Influence on Mass.*

The virial radius of mean momentum not only determines the centre of gravity of the two chief planetary masses (15), (40), but it also determines the relative masses of Sun ($m_\circ$) and Jupiter (m_5) at initial nebular rupture (secular perihelion). We find, accordingly,

$$m_\circ r_\circ = m_5 \rho_{5\cdot1} \qquad 52.$$

Stockwell's estimate of Jupiter's secular eccentricity is ·0608274. This gives $\rho_{5\cdot1} = {\cdot}9391736 \times 5{\cdot}202798 \times 214{\cdot}45 = 1047{\cdot}872 r_\circ$. Therefore (52):

$$m_\circ = 1047.872\, m_5 \qquad 53.$$

Bessel's estimate is 1047·879. This harmony is the more significant because Jupiter's nebular locus of incipient rupture (4·8863) is central between the loci of incipient subsidence of Uranus (20·6792) and Neptune (30·4696) at opposition.

$$\rho_{5\cdot1} = \tfrac{1}{2}(\rho_{7\cdot3} - \rho_{\varphi 3}) \qquad 54.$$

394. *Successive Orders of Photodynamic Influence.*

While Jupiter traverses the primitive nebular centre, Earth traverses the centre of the belt of greatest condensation.

$$\tfrac{1}{2}(\rho_{1\cdot1} + \rho_{\varphi 3}) = \rho_3 \qquad 55.$$

Stockwell's estimates for the secular limits of the dense belt (Mercury$_1$ and Mars$_3$) are, $\rho_{1\cdot 1} = \cdot 2974$; $\rho_{4\cdot 3} = 1\cdot 7365$. This gives for (55) $1\cdot 0169\,\rho_3$, which is nearly $\frac{1}{\pi}$ of the mean proportional (27) between Sun's radius ($r_\circ$) and the solar modulus of light (29). These successive indications of virial influence upon Saturn and Jupiter (40), Sun and Jupiter (53), Uranus and Neptune (54), and the relative positions of the dense planets, are full of suggestive interest.

395. *Virials of Secondary Rotations.*

While the rotation of the chief nucleal centre (Sun) is determined by the velocity of light (3), the rotations of the secondary centres of nebulosity (Jupiter) and condensation (Earth) are determined, respectively, by circular orbital velocities at Sun's surface [$v_\circ$] and at the mean centre of gravity of Sun and Jupiter [v_s].

$$g_3 t_3 = [v_\circ] = \sqrt{g_\circ r_\circ} \qquad 56.$$

$$g_3 t_3 = [v_s] = \sqrt{g_s r_s} \qquad 57.$$

The data for the solution of (57) have been more accurately and satisfactorily determined than for (56).

$$g_3 t_3 = \frac{32\cdot 088}{5280} \times \frac{86164\cdot 08}{2} = 261\cdot 821 \text{ miles} \qquad 58.$$

396. *Jupiter's Diameter and Density.*

Circular orbital velocity varying inversely as $\sqrt{r}$, we find (52), (53), (57), (58)

$$g_5 t_5 = [v_\circ] = g_3 t_3 \div \sqrt{.9391726} = 270\cdot 167 \text{ miles} \qquad 59.$$

$$[v_s] = [v_\circ] \div \sqrt{214\cdot 45} = 18\cdot 449 \text{ miles} \qquad 60.$$

Hall's estimate of the period of Jupiter's rotation ($9^h\ 55^m\ 26^s.5$) gives

$$t_5 = 4^h\ 57^m\ 43.25 = 17863.25 \text{ seconds} \qquad 61.$$

Substituting this value in (59) we find

$$g_5 = 79\cdot 856 \text{ ft.} = 2\cdot 4887\, g_3 \qquad 62.$$

Hence, by (53) and (69)

$$m_5 = 315\cdot 38\, m_3 \qquad 63.$$

$$r_5 = 11\cdot 257 r_3 \qquad 64.$$

$$\delta_5 = \cdot 2211 \delta_3 \qquad 65.$$

Different estimates of Jupiter's mean apparent semi-diameter give values for r_5 ranging between $10\cdot 8 r_3$ and $11\cdot 5 r_3$

397. *Sun's Mass and Distance.*

Earth's gravitating acceleration and its orbital velocity (60) being known, we have all the data which are needed for estimating Sun's relative mass and mean distance.

$$\rho_3 = 31{,}558{,}149\ [v_3] \div 2\pi = 92{,}662{,}000 \text{ miles} \qquad 66.$$

$$r_\circ = \rho_3 \div 214\cdot 45 = 432{,}090 \text{ miles} \qquad 67.$$

At Earth's surface, $\sqrt{gr} = 4{\cdot}9073$. It varies as $\sqrt{\frac{m}{r}}$. Therefore (60)

$$\frac{m_\odot}{\rho_3} : \frac{m_3}{r_3} : : 18{\cdot}449^2 : 4{\cdot}9073^2 \qquad 68.$$

$$m_\odot : m_3 : : 330482 : 1 \qquad 69.$$

All of the results which have been drawn from (3), (56), and (57) involve the principle of persistency of vibrations, by which waves tend to propagate themselves indefinitely, with the velocity which is due to their locus of origination.

398. *Masses of Earth and Venus.*

The influence of Jupiter's locus of incipient subsidence on the comparative masses of Jupiter and Saturn, finds some analogy in the two chief planets of the dense belt, Earth and Venus.

$$m_2\rho_{2\cdot3} = m_3\rho_3 \qquad 70.$$

Substituting Stockwell's estimate of the secular aphelion of Venus ($\rho_{2\cdot3} = {\cdot}7744234\rho_3$) in (69), (70).

$$m_\odot = 426750m_3 \qquad 71.$$

Hill's estimate is 427240, which differs from (71) by less than $\frac{1}{8}$ of one per cent. The combined virial estimate of Earth's relative mass (69) differs from the purely oscillatory estimate (Note 23) by less than $\frac{1}{5}$ of one per cent.

399. *Comparisons of Potential.*

In order to test the numerical accuracy of the general equation of kinetic-velocities (24) we may begin with the consideration of potential energy, which has been largely treated in thermodynamics. Gravitating potential is usually measured by the height of possible fall, or of *virtual* fall, since the heights which are considered are commonly so small that the variation of g is insignificant. The time of fall (t_α), or the velocity which would be communicated by the fall (v_α), might be taken with equal propriety as the basis of measurement and comparison. The cosmical determination of Joule's equivalent (*Proc. Am. Phil. Soc.*, xix, 20), shows the importance and advantage of adopting fundamental units which can be readily employed in the greatest possible variety of directions.

The general equation of fundamental velocity (24) rests on Laplace's principle of periodicity, "that the state of a system of bodies becomes periodic when the effort of primitive conditions of movement has disappeared by the action of resistances." Hence (3), (8).

$$v_\lambda = v_\gamma \qquad 72.$$

Moreover, the natural standards of time, gravitating acceleration, distance, oscillation and undulatory velocity which are indicated by the solar periodicity of synchronous rotation and evolution at Laplace's limit, solar superficial attraction, Sun's semi-diameter, and luminous radiation, obviously give the following further equality :

$$v_\alpha = v_\beta = v_\zeta = v_\eta = v_\theta = v_\lambda \qquad 73.$$

400. *Completion of Correlation.*

In Coulomb's formula of torsional elasticity (Note 162), if we substitute $\frac{m}{2}$ for f, $gt^2 = M$ (29) and

$$gt = v_\lambda = v_\delta \qquad 74.$$

The investigations of Weber, Kohlrausch, Thomson, Maxwell, Ayrton, and Perry have shown that

$$v_\lambda = v_c \qquad 75.$$

Notes 16, 90–3, 97 give various ways of coördinating chemical and cosmical actions with luminous undulation, so as to get the equation

$$v_\kappa = v_\lambda \qquad 76.$$

In throwing a ball into the air, the thermal equivalent of projectile force is equivalent to the product of the mass by the sum of the retarding resistances. In solar superficial radiation, the gravitating reaction is exhausted in a half rotation. By a simple extension of these principles we have deduced equations 73–6, which, when combined, give a complete practical verification of the general kinetic correlation (24).

401. *Phyllotaxy and Harmony of Absorption Bands.*

Langley's observations with the spectro-bolometer, at Allegheny Observatory and on the summit of Mt. Whitney, show four remarkable absorption bands in the infra-red portion of the solar spectrum, at 0.$^\mu$94, 1.$^\mu$14, 1.$^\mu$37 and 1.$^\mu$83. These wave-lengths are very nearly proportional to the numbers 4, 5, 6, 8, as is shown by the following table:

	Harmonic.	Observed.
α	·93	·94
β	1·15	1·14
γ	1·38	1·37
δ	1·84	1·83

They give, therefore, the following phyllotactic approximations: $\alpha \div \beta = 2 \times \frac{2}{5}$; $\alpha \div \gamma = \frac{2}{3}$; $\alpha \div \delta = \frac{1}{2}$; $\beta \div \delta = \frac{5}{8}$. The phyllotactic harmony is modified by an approximate repetition of the harmonic ratio $\frac{5}{6}$.

	Harmonic.	Observed.
α_0	95	.94
β_0	114	1.14
γ_0	136.8	1.37

We thus find, wherever we look, abundant evidence, not only of primary harmonic influence, but also of secondary and subordinate modifications which need to be carefully studied in connection with virial researches.

402. *Consequences of Ferrel's Law.*

The science of Meteorology may, for many good reasons, be regarded as a peculiarly American science. William Ferrel's discussion of the motion of fluids and solids relative to the Earth's surface, which was first published in the summer of 1856, placed the laws of cyclonism and anticyclonism on

a solid mathematical basis. He showed that, in the northern hemisphere, all moving bodies are constantly subjected, in consequence of the Earth's rotation, to a deflection towards the right hand. Hence all atmospheric surface currents which are mainly governed by a downward pressure, tend to curve in the direction of the hands of a watch, or successively through north, east, south, west. All surface currents which are mainly governed by an upward pressure, tend to flow in an opposite direction, or through north, west, south, east.* The heavy winds are called anticyclonic; the light winds, cyclonic.

There can be no descending currents in one place without ascending currents in another; therefore, in every atmospheric disturbance, there must be simultaneous cyclonic and anticyclonic winds. Such disturbances originate either in an unusual cooling and condensation, or in an unusual heating and expansion of air. In the former case the inflow, in the upper regions of the atmosphere, will produce an increased pressure. In the latter, the outflow will produce a diminution of pressure. In the restoration of equilibrium, currents of warm air are often brought into contact with colder currents. If the currents are both saturated with moisture, or if they contain more vapor than can be retained under the temperature of the mixed currents, precipitation takes place, in the form of rain, hail, or snow. This precipitation reduces the weight of the atmospheric column and the barometer falls. Accordingly, there is a constantly increasing tendency to cyclonism about storm centres, and there has been a very prevalent disposition to look upon all storms as of cyclonic origin.

A little reflection, however, will show that the initial mixture of currents may be due to either of the causes above mentioned; either to the flow of warmer air into a cold depression at the top of the atmosphere, or to a flow of cold air, at the earth's surface, towards a region of low barometric pressure. In the former case, the initial superficial currents are determined by a downward pressure, and they are, therefore, anticyclonic; in the latter they are determined by an upward pressure and are cyclonic.

A careful study of the weather maps shows that the heaviest rains and snows occur in advance of the centres of low barometric pressure, or in the rear of the centres of high barometric pressure. If storms began in the cyclonic currents, the reverse should be true; the greatest effect following the low centre and preceding the high centre.

The frequent failures of forecasts, during the past winter, seem to have been mainly due to a misinterpretation or a misconception of these facts, to which the writer first called attention in 1871.

403. *Study of Stormy Anticyclonism.*

Loomis's discussions (Note 367) show the need of watching the development of storms at all stages, from the first indications of atmospheric

*This will be evident, if we imagine ourselves to be lying in the current and facing the direction towards which the pressure tends.

disturbance, until the restoration of fair weather. The limit between anticyclonic and cyclonic tendencies, may be approximately assumed to be midway between the centres of high and low barometric pressure. All cloudiness or precipitation between the limit and the high centre, represents anticyclonic influence ; all between the limit and the low centre represents cyclonic influence. Local cyclonism sets in soon after precipitation begins, and the anticyclonic influence is thus partially hidden ; but a critical examination of the weather maps will show that the prevailing currents of the region often continue to be anticyclonic until the rain or snow is nearly, or quite over. The evidences of storm breeding and stormy anticyclonism will be still more striking, if the changes of barometric pressure are studied in connection with the beginnings and subsequent growth of cirrus, cumulus, and nimbus clouds, as well as with the rainfall and the final breaking up of cloudiness. There are good reasons for believing that such study, systematically and thoroughly continued under the direction and with the facilities of the Signal Service Bureau, would raise the successful verifications of the Washington forecasts to an average of at least ninety-five per cent.

404. *Pressure of Warm Air.*

Dr. Köppen, in discussing Ley's work on the winds prevailing in Western Europe, announces four new theorems (*Ann. hydr. und magnet. marit. meteor.*, 1882 ; cited by *Science*, **499**). 1. The air-currents deviate from the isobars towards the side of the lower pressure in the lower atmosphere, and of the higher pressure in the upper atmosphere. 2. An excess of pressure exists upon the side of the warmer air-columns. 3. The depressions advance approximately in the direction of the air-current which has a preponderance of accumulated energy. 4. The state of motion of a certain mean layer, of which the height is still to be determined, can in general be substituted for the onward movement of the vortex. A systematic comparison of these propositions with observations and with Blasius's discussion of aerial currents (*Storms*, chapter iii), may contribute towards a fuller knowledge of stormy anticyclonism. It will also be interesting and instructive to see how readily Köppen's theorems can be deduced from Ferrel's laws.

405. *Solar-Barometric Virials.*

The first physical paper which I communicated to the American Philosophical Society (*Proc. A. P. S.*, ix., 283-8) was based on virial considerations, but the discussions of Clausius had not prepared the way for their general acceptance. Accordingly, the method of treatment was so new, that many persons looked upon the results merely as curious and, perhaps, accidental coincidences. The foregoing relations of virial influence to time of rotary oscillation enable us to reach the same results in a more simple way.

The mean barometric fluctuations, both daily and annual, may be re-

garded as functions of time, mass and distance. The mean daily disturbances take place at $r_3 = 3962.8$ miles from the virial centre; the mean annual disturbances at $\rho_3 =$ Earth's semi-axis major from their virial centre. The disturbed atmospheric mass and the equilibrating value of g are the same in both cases. The virtual potential of daily rotation is $\frac{g}{2} \times 86164.08^2 =$ 22,559,593.75 miles. Gen. Sabine's means of five years' observations at St. Helena, show a daily barometric range of .067 in., and an annual range of .135 in. (see *Proc. Am. Phil. Soc.*, x, 375, foot-note). The geographical, magnetic and climatic situation of St. Helena is such as to give the following simple harmonic approximation for ρ_3 (Note 377 ; 5).

$$.067^2 : 135^2 : : 22,559,593.75 : 91,590,200 \text{ miles.}$$

406. *Encke's Comet.*

Dr. O. Backlund (*Copernicus*, Feb. 1883 ; cited in *Science*, **531**), says that "the investigations hitherto made of the theory of Encke's comet really prove nothing as to the existence of a resisting medium in space. Even if we should succeed by such an hypothesis to explain sufficiently the increase of the mean motion and the decrease of the eccentricity during the period 1819–48, a simple hypothesis like this will not at the same time suffice for the motion of the comet after 1865, as the variation of the mean movement after that time has most probably become different. Not until the period 1865–81, and its connection with the earlier one have been fully discussed, will it perhaps become possible to find indications of the nature of the unknown forces which act on the comet." If an æthereal medium is set in vibration by the passage of comets or other cosmical bodies, there will be, as in the case of tidal disturbances, both accelerating and retarding influences. We must know more than we now do, of the nature of the medium as well as of the laws of elasticity, before it will be safe to dogmatize about a resisting medium or about the second law of thermodynamics. The equality of action and reaction may, perhaps, set limits both to nucleal condensation and to æthereal expansion, the two limits being opposite phases of cyclical changes which all matter is always undergoing. The unity of energy which is indicated by æthereal relations of mass and velocity (Notes 388, 400), gives great likelihood to this hypothesis.

407. *Sound-Spectra.*

Frazer's "Examination of the phonograph record under the microscope" (*Jour. of the Franklin Inst.*, lxxv, 348 ; *Proc. Am. Phil. Soc.*, xiii, 531), showed that each of the alphabetic sounds has a special combination of vibrations, which may be visibly impressed upon a metallic sheet. The harmonic correspondence between the wave-lengths of musical notes and those of the principal lines in the visible spectrum (*Proc. Am. Phil. Soc.*, xiii, 149), increases the probability that there may be an unbroken series of waves, from the lowest audible sound to the highest actinic impulse. Mayer's experiments with the antennæ of mosquitos and Langley's ob-

servations of absorption bands (Note 401), approximate the gamuts of light and sound and suggest the desirableness of some more sensitive method for recording audible waves and interferences than is furnished by the phonograph. The radial virials of light and the tangential virials of sound (Note 390) furnish a field for research which is almost wholly unexplored. In view of the wonderful advance of spectral photography during the last decade, we may venture to hope that the record may sometime be extended so as to include the interferences of sound-waves.

408. *Investigators of Spectral Harmony.*

The earliest indications of harmony in spectral lines of which I have found any record, were given by Prof. Gustavus Hinrichs, in the American Journal of Science for 1864 (vol. xxxviii, p. 31, seq). In the Comptes Rendus of the French Academy, for 1869 and 1870, Lecoq de Boisbaudran published several harmonies of a character analogous to those of Hinrichs, his first paper being deemed of so much importance that the Academy allowed its insertion without abridgment, although it exceeded the statutory length. He referred to a communication of Mascart, on the same subject, in August, 1868, and also to a *pli cacheté* of his own which was deposited in the archives of the Academy in 1865. G. Johnstone Stoney (*Rept. Brit. Assoc.*, 1870; *Proc. Roy. Irish Acad.*, 1871; *P. Mag.*, 1871) and J. L. Soret (*Bib. Universelle*, Sept. 15, 1871, cited in *P. Mag.*, 1871, xlii, 464) seem to have been next on the list. My own investigations began in 1864, with the study of "oscillations moving with the velocity of light" (*Proc. Am Phil. Soc.*, ix., 408), but my first indications of harmonic wave-lengths were not published until 1873 (*Ib.*, xiii, 150). Guided by a conviction of the physical necessity that all æthereal undulations must be harmonic, I have been led into the discovery of a great variety of spectral and other coördinated harmonies.

409. *Velocity of Wave Propagation.*

As there has been some misapprehension with regard to my deduction of the relation between the mean velocity of oscillating æthereal particles and the velocity of wave propagation (Note 384), it may be well to explain the ground on which it rests. In considering the "uniform wave of oscillation," in a star which is rotating under the condition that $g_o l_o = v_\lambda$ (Note 379), the *vis viva* of a revolving particle at l (Note 381), is $\frac{1}{2}$ as great as the *vis viva* of the same particle from the indefinite fall* which has produced central condensation. *Vis viva* varies as distance of possible projection against uniform resistance; therefore l and $\frac{1}{2}l$ may be taken, respectively, as the measures of the virials of indefinite and of virtual fall. Hence arises a tendency to the formation of an oscillatory node at $\frac{1}{2}l$, together with a tendency to the radial projection of the node, in the equatorial plane, by

* This is rigidly true only when the fall is infinite, but in falling from Neptune to Sun the deviation from exactness would be less than $\frac{1}{1\,1\,1}$ of one per cent.

the centrifugal force of rotation. The direct and reciprocal centres of linear oscillation, at $\frac{2}{3}\,l$ and $\frac{1}{2}\,l$, tend to throw the node at $\frac{1}{3}\,l$ from or toward the centre. The reciprocal centre, $\frac{1}{2}\,l$, is pivotal in respect to the direct centre, $\frac{2}{3}\,l$, thus producing a secondary centre of linear oscillation at $\frac{1}{6}\,l$. This indicates the relative *vis viva* of radial projection which corresponds to an oscillatory tangential *vis viva* of l. The corresponding relative velocity is $\sqrt{\frac{1}{6}}$.

410. *Propagation of Explosive Waves.*

Berthelot and Vieille (*Ann. de Chim. et de Phys.*, xxviii, 293) give the equation $\theta_1 = \theta_0 \sqrt{\frac{Q+q}{q}}$, in which Q is the amount of heat set free at the moment of chemical combination; q, 273 times the specific heat; θ_1, the velocity of explosive translation of gaseous molecules; θ_0, the velocity of mean translation after the explosive wave has ceased to exert any influence. They have verified the formula approximately, for a score of gaseous mixtures of very various compositions. They think that in the act of explosion a certain number of molecules are thrown forward with all the velocity corresponding to the maximum temperature developed by the chemical combination; this movement is transmitted from one inflamed edge to another, in a wave which is propagated with a velocity either identical, or comparable, to that of the molecules themselves.

Introduction to a Study of the North American Noctuidæ. By A. R. Grote, A. M.

(*Read before the American Philosophical Society, June 16, 1883.*)

In my "List of the Noctuidæ," 1874, the "Check Lists" of 1876 and 1882, my "Illustrated Essay" and a number of different papers, I have explained the characters of *Noctuidæ*, a family of moths of nocturnal habit and of very general distribution. These structural features, which are used in establishing genera and other divisions are briefly summarized as follows, taking the three divisions of the body in turn:

I. The *Head:* character and structure of the compound eyes, which are either full or ovate, small, large, or more or less constricted, and have their surface naked or studded with hair, and the orbits sometimes provided with longer hair, dependent over the eye and called *lashes;* the character and structure of the clypeus or front, between the eyes, which is swollen or flat and sometimes provided with a tubercle, or horns of various shapes and sizes, or a depression; the presence of ocelli; the shape and size of palpi and tongue; the vestiture of the different parts.

II. The *Thorax:* the shape of the wings, their squamation and neuration; the structure of the feet, the tibiæ being variously spined, or armed with claws, or again unarmed, the tarsi which are always spinose show a variation in the character of the spines; the shoulder covers or patagia may be either deflected or closely applied; the collar which varies in size and shape.

III. The *Abdomen:* its comparative length and form; the male genitalia which vary in shape, the female ovipositor may be protruded or not.

General characters may be drawn from the vestiture and tuftings along the dorsal lines of the body. The clothing of the thorax varies from hairy to being composed wholly of flattened scales. I have also used the infraclypeal plate at the base of the "front," which is variously produced and in *Rhodosea* seems slightly mesially projected. Comparative characters are offered by the size of the appendages, width of clypeus, the retraction or projection of the head. Secondary sexual characters are to be used as of generic value when they are of such a nature, that if shared by both sexes they would be held sufficient to found a genus upon. This would exclude the antennæ from their variability, so far as the usual pectinations are concerned, but admits such abnormal male characters as are offered in the antennæ of the genera *Renia, Syllectra*, etc.; also the genitalia, upon which sections may be founded, but which do not seem to be sufficiently stable in their modifications to form part of the diagnosis. The color and pattern of ornamentation often give a clue to the affinities of a species and, in my opinion, should not be entirely disregarded, but afford no ground by themselves to establish any structural group. The immature stages, egg, larva and chrysalis should also be studied, and they will often give a certainty as to the location of a form not to be attained in any other way. Unfortunately they are generally unknown; on this account alone our classification is provisional and it must remain so to a greater or less extent so long as the natural history of the family is not completely known and studied.

The family *Noctuidæ*, then, may be said to contain moths, having 12-veined forewings, of which vein 5 belongs to the series attached to the median vein, being nearer vein 4 than vein 6, except in the genus *Nolaphana*, where it seems to be nearly central in its location, and having two internal free veins on the hindwings. This latter character divides them from the *Pyralidæ*, a family which the lower genera of the *Noctuidæ* approach in general form. The former character separates them from the *Geometridæ*, a family which is lower and next succeeds the *Noctuidæ*, as may be seen from the fact that the larval form which is characteristic of the *Geometridæ* only obtains in certain lower genera of *Noctuidæ*, which, in the perfect stage, also show a tendency (*Homoptera*) to copy the position of the wings in repose, and the ornamentation habitual with the *Geometridæ*. The wings in the *Noctuidæ* are entire, except in *Eulintneria*, in which genus the male has a slip on the external margin, a secondary sexual character of generic value. They have a simple frenulum in the

males, which is divided (not "double") in the females. The wings may be said to be short and narrow; they broaden in the lower genera and again in some genera may be said to be long in comparison with the body (*i. e., Cucullia*, etc.). The ocelli are almost always present, while in the *Geometridæ* they are almost always absent. The palpi lengthen as we descend to the lower genera, where they assume unusual shapes as in *Palthis*. The male antennæ are ciliate, bristled, brush-like or toothed and pectinate, the female antennæ being almost always simpler in structure; *Renia*, *Zanclognatha*, and other genera have them furnished with tufts, coils of hair or nodosities. The "front," or clypeus, is broad and square as compared with either the *Geometridæ* or *Pyralidæ*. The maxillary palpi are short and concealed. The tongue is equally stout, but occasionally short, weak or rudimentary. The eyes are full, and may be either naked or hairy, the hairs being weak and short in *Trichocosmia*, but usually prominent as in *Mamestra*. The orbit of the eye is furnished with a more or less complete circle of hair in some genera, and there is often a circle of discolorous scales lying back from the orbit. The vertex of the head is sometimes clothed with scales, differing in shape and position from those on the "front," which are often short and converge mossily about a central protuberance varying in character. The thorax is short and stout, thickly scaled and often tufted on the dorsal line, with the tufts divided in some genera, and more or less lengthy and peculiar. The metathorax is short; the middle region of the body is well developed as compared with the other families and muscular, the base of the wings and their framework of veins being usually stout and stiff; the flight is most often strong and rapid, and approaches that of the *Sphingidæ*. The habit of hovering over flowers is characteristic of certain genera such as *Plusia*. The abdomen is conical, and usually exceeds the hind wings, the contour is definite; it is variously tufted, or again smooth or with a carina on the dorsal line; again it is flattened, seldom weak or short.

The colors are brown and gray. The hind wings are quite highly colored, but, as a rule, simple and slight in their markings as compared with the fore wings; oftenest they are quite plain or with one or two cloudy lines parallel with the outer margin and a discal spot. The fore wings are usually distinctly lined. They have a basal half-line (b. h. l.), an inner median or transverse anterior (t. a.) line, a median shade (m. s.), an outer median or transverse posterior (t. p.) line, a subterminal line (s. l.), a terminal line (t. l.) at the base of the fringes. There are three stigmata: the *orbicular*, a rounded anterior spot on the cell; the *reniform*, a usually kidney-shaped spot outward the cell; the *claviform*, a pointed spot attached to the t. a. line below the orbicular. In the genus *Catocala* there is also a subreniform spot, while the claviform is absent. The typical ornamentation is displayed in such genera as *Hadena* and *Mamestra*. Almost always it can be made out and its presence renders a description recognizable if drawn up with care, and the different lines and spots, which are thus easily executed, fully and

comparatively described. The descriptions in French of M. Guenée seem to me very good as a rule, and, as a consequence, but few of his North American species are in doubt. A study of the ornamentation of the *Noctuidæ* is interesting. In related species I found that the differences showed themselves first on upper surface of primaries, then of secondaries, lastly, beneath.

I only mention the genus *Catocala* now to refer to a paper, published by me some twelve years ago, in which I identified one species previously described, and in order to recall the fact that I showed that the origin of the subreniform spot to be the outer median (transverse posterior) line itself. It here set back a sulcation which became gradually separated from the line, and in some species now appears as an almost round spot without any connection with its point of origin. In like manner I conceive the stigmata to have originated. The reniform probably form the median shade, the orbicular and claviform form the inner median (t. a.) line. The spots are then developments from the transverse lines, although it may not be certain whether the reniform is not a relic of a former band, or perhaps of the outer line, though this is not so probable, judging from the course of the median shade, which, in some species, seems to be interrupted by the reniform. Every one has read or should read the best chapter in Mr. Scudder's book on butterflies, that on classification and origin, and will remember his theory of the primitive style of marking, a succession of lines following the shape of the outer margin. It seems quite exact to me from my previous studies of the markings of the *Noctuidæ*. It also works in with my conclusions as to the law of variation in this group, which I showed affected the upper surface of fore wings first, then the hind wings, and then the under surface, following the exposure of the surface, to the light and air.

From these characters we may offer the following *résumé* by which the student may recognize a Noctuid. The front is square and broad, the labial palpi are divergent and prominent, obliquely ascending, the second joint longest and thickly pilose, the ocelli are present, the eyes are full, the tongue stout, the maxillary palpi concealed, the antennæ thread-like, ciliate or brush-like, rarely pectinate in the males. The thorax is heavy and stout, the prothorax broad and distinct, the patagia relieved, the metathorax very short, the flanks broad; the wings stiff, strong and short, the secondaries plain, covered by the fore wings in repose, the primaries 12, the secondaries 8 veined, the latter with two internal veins counted as one; the legs are strong, tarsi spinose, tibiæ sometimes with claws or spines. The abdomen is conical, and exceeds the hind wings, its contour defined. The vestiture is hairy or mixed with flattened scales, usually dense.

The *form* of the *Noctuidæ* (as insisted on by Agassiz as a family character), united three structurally distinct groups, regarded as families by Lederer. The first of these is represented in our fauna by a few species, and is nowhere numerous. No name hitherto employed for it is tenable

under an amended nomenclature. Dr. Harvey and Dr. Packard have shown that the term *Cymatophora* is to be applied to a genus of *Geometridæ*. The terms *Bombyciæ* and *Noctuobombyceini* have not a proper form. Only one of the genera comprising it is beyond dispute, and is represented in Europe, Asia and America by distinct species, viz. : *Thyatira*. I shall call this group, then, *Thyatiridæ*. It differs by the course of vein 8 of the secondaries, and the position of vein 5 of the primaries from all the rest of the *Noctuidæ*. The second family is the *Noctuidæ* proper. It contains subfamilies, which I have designated in my "New Check List," and which I discuss here so far as the present paper extends. Other writers have seen in it three principal groups, the *Non-fasciatæ* of Borkhausen (= *Noctuinæ* of Packard) and the *Fasciatæ* (= *Catocalinæ* Pack.) ; also the *Deltoides* of Latreille, so called from the wings in repose forming the outline of the Greek letter Delta (Δ). At the time of writing his paper, Dr. Packard seems to have regarded the latter as *Pyralidæ*. It is not possible to separate them from the lower *Noctuidæ* as shown by Dr. Herrick-Schæffer. They fall into two subfamily groups : the *Herminiinæ* and *Hypeninæ*. The differences between these groups are a mere extension of the general comparative characters by which smaller assemblages of genera may be defined. I have restricted Dr. Packard's terms to two special groups of smaller extent, and these I believe to have an equivalent value to his subfamily groups in the *Geometridæ*, and which I have discussed above. We have then in the Noctuidæ primarily three families :

I. THYATIRIDÆ.
II. NOCTUIDÆ.
III. BREPHIDÆ.

This last, again, a group of very limited extent, destitute of ocelli, broad winged and hirsute, has vein 5 midway between 4 and 6, but differing by the neuration of secondaries from the THYATIRIDÆ.

In the *Thyatiridæ* no subfamily groups seem to me recognizable since the discovery of our Western forms, *Thyatira Lorata* and *Bombycia semicircularis*. At first sight the genera *Leptina* and *Bombycia* (= *Cymatophora*), and again the genera *Thyatira*, *Pseudothyatira* and *Habrosyne* (= *Gonophora*) seem to afford two series which in the European fauna appear distinguishable. Hubner was the first to associate these genera, some of the earlier European writers classifying *Thyatira* with *Plusia*. In our fauna *Pseudothyatira* stands nearest to *Habrosyne*, while our species of *Thyatira* approach our two *Bombycide* in several respects.

The general characters of the moths of the *Noctuidæ* I have thus gone over quite fully, and I now mention those of the subfamily groups, after a few remarks which suggest themselves to me, since I finally deal with the subject after a quarter of century of more or less continuous study of it. As to nomenclature, the Preface to Staudinger and Wocke's Catalogue seems to me to give the most practical and feasible rules whereby the choice of names is to be regulated. There should be a uniformity in

family and subfamily terminations, and I am finally opposed to the barbarous names used by Mr. Scudder for these groups in the butterflies.

There is a certain amount of natural error which a student may fall into while gradually becoming acquainted with a large amount of new and differing species, as to which no work was before him, and through which he had to break a path. All things considered, no one in my position could have escaped having to change his views and cancel some of his work. I have always quickly acknowledged and corrected my mistakes, as all who have followed and used my previous writings, I think, admit.

With these explanatory remarks, I would now offer a *résumé* of my conclusion and studies on the family.

It must be acknowledged that the *Noctuidæ* are difficult of limitation as a family by exclusive characters. They may be shown to differ in turn in single points from other family groups of moths, but certain genera in every fauna are difficult to place. As to subfamilies, Lederer shows that these can only be defined comparatively, and not exactly, or, as he calls it, scientifically. The groups here recognized are merely tentative associations of genera to which I have given a subfamily name; they contain all of them genera which may be displaced by future enquiries, but they help the comprehension of the family and enable us to consider certain assemblages together. As to their names, I have not followed any rule of priority; Guenée gives some of them a family form. I have given them a uniform termination, and derived them from the most prominent genus they contain.

The summer, that pulse of the year, the length of whose recurring beat is at once the measure of the time elapsed since the culmination of the last ice period, gives us a prevailing northward direction for the winds that sweep the North American Continent. These offer ærial paths along which numbers of feathery-winged moths are hurried. We have wind visitors from the West Indies upon our shores during the whole season. Some of these become partial citizens by breeding here, others do not, and their lodgment upon our territory is precarious and accidental. The list of species known to visit us in this manner is already somewhat extensive, while the southern part of the peninsula of Florida is occupied permanently by the assemblage of tropical insects. This subject leads us to consider briefly the distribution of our *Noctuidæ*.

The *Geographical Distribution* of the North American *Noctuidæ* must be studied in connection with the topography of the country and the range of the food-plants of the caterpillar. It is found that mountain chains afford the most effective barrier to the distribution of species. Their presence explains the fact that Ohio insects are often absent in New York, or not so abundant on the north and east of the Alleghanies. A study of the ranges and lateral branches of the Rocky mountains, as they are delineated, gives an idea of the different faunal provinces which are discovered to be more or less restricted to the valleys between the spurs. It is shown that, often at short distances in this region, the character of the moths in

adjacent valleys changes. We have essentially one fauna, which is arrested at the St. John's river by a tropical colony inhabiting Southern Florida. The Labrador fauna is a true extension of the Canadian, and the *Noctuidæ* of that region may be found again inhabiting the sides of Mount Washington. I disagree then with Staudinger, who includes the Labrador with the European fauna, believing him to be misled by the identity of alpine species with our more northern forms. On the west our fauna extends downwards along the table-lands occupying the centre of the Mexican peninsula, the hot and low lands on either side being occupied by a different and tropical fauna. Singularly enough some more northern west coast species have been found in Maine and Canada. There must be a northern outlet in the mountain ranges of the Pacific coast. The principal feature in the distribution of our fauna is the migrations. A yearly zoölogical wave sets in from Mexico and the West Indies, and carries on its crest a number of light-winged *Noctuidæ*, which eventually range up our entire coast, and are found in Maine in the fall. The most important to us of these species is the cotton worm, which I have studied a long time. This moth, which feeds on the perennial cotton of South and Central America, must have visited our mainland for years before the cultivation of our annual cotton gave it a lodgment on our soil. Now it increases by the rich fields offered as food for its larva, and traverses the country in successive broods from the South to the Ohio river. Beyond this it flies, but it is doubtful that it again accomplishes its transformations on a substitute food-plant in the fall. The probability is that it does. I originally showed that, in the South, it would feed on nothing but cotton, from my observations and experiments. I find now that Prof. Riley occupies my ground, and states that it *only* feeds on cotton and that its northern journey is fruitless. I originally discovered that the whole inquiry, from an economical point of view, hinged upon the discovery of its successful hibernation, after being the first to positively ascertain that it wintered as a moth.

In my paper (1874) I suggested that this might still be extra limital or confined to a narrow southern strip of land in Texas or Florida. In this I was probably mistaken, and it may be that it has a hold throughout the cotton belt. But I wish to point out distinctly that this was the matter to be ascertained, and that my theory is to-day the correct one. It showed that the area of successful hibernation was the point for future enquiry, and I suggested in the *Tribune* the means to get this information, and the preventive measures to be employed, if this region was such as could be dealt with by preventive measures in the spring. As to its extra limital origin, Professor Riley finds a short letter anticipating my theory, but necessarily presenting few facts as the range of North American *Noctuidæ* was not then known. However this may be, neither Prof. Riley nor I knew of this letter, when I read my paper in 1874, five years after I had formed my conclusions. To suggest that my theme was not original, is to deal unfairly with the facts. I have shown that Prof. Riley did not

study the cotton worm in connection with the cotton plant. I protest against his Cotton Worm Report as doing me throughout grave injustice. I find even the moths which I named for Professor Baird, which were mistaken for cotton moths by unskilled observers, recapitulated in this report, in which my observation as to the larval feet of *Aletia* and *Anomis* is appropriated. I have named moths for Prof. Riley for twenty years. He even lately tries to make me responsible for his re-description of the "Corn-bud Worm" of Abbott and Smith, the *Laphygma frugiperda* of authors, as a new *Prodenia autumnalis* Riley; and quotes a fragment of a private letter of mine to substantiate the charge. But I never saw the moths till after he had named them, and my letter merely acknowledges the specimens, and gives no opinion on the matter. Since 1864 I knew Abbot's work thoroughly, as shown by my writings on the *Sphingidæ*, and my identification of his species.

As to practical Entomology I allow myself here to express an opinion founded on my experience. The reports of State entomologists often reiterate a good deal, and do not seem to reach the farmers for whom they are intended. An inquiry about the way in which the money of the United States Entomological Commission has been spent with the results attained will show, I am confident, that the facts it has published have not reached the great body of American agriculturists, the principal parties interested.

The system of State entomologists must be changed, and these officials should lecture before the public schools and institute meetings in the county districts, and thus bring the outlines of entomology and a knowledge of common pests before the young. In this way farmer boys will learn to respect robins' nests and pull down the nests of the tent caterpillar instead. As matters are now, it is little use of one man's cleaning out his orchard while another next door keeps a breeding place for the codling moth. Public education must take charge of the matter, and there will then be a prospect of saving much that is now wasted. From a perusal of Mr. Wm. Saunders' excellent book* on "Insects Injurious to Fruit Trees," it is plain that personal labor and mechanical appliances for jarring and gathering or crushing are better than poisons in most cases, and I reiterate here the opinion I expressed at the Saratoga meeting of the American Association, that the use of Paris green is to be deprecated from the liability of poisoning to stock, and the persons handling it, to say nothing of its criminal use which has not unfrequently happened.

In the following arrangement I have given our *Thyatiridæ* and the bulk of the *Noctuidæ* down to the *Catocalinæ* and *Deltoids*. All the genera are here cited, but I have only given the species described by myself as a rule; the other species are cited in my "New Check List," and do not usually give different characters from those here presented, which I have

* This work (which should be used in public schools), from its admirably simple and correct style, its illustrations and arrangement of material used, is entitled to be regarded as the best on the subject since the now classical treatise of the late Dr. Harris.

specially studied. I have also omitted the synonyms and subgenera. I follow this list by a discussion of the twenty-four groups into which I have divided the genera, and conclude the paper by special generic descriptions.

I trust this paper will be of general service to the student, and it is offered as my probably final contribution to a knowledge of this interesting group. The paper was written for the most part several months ago, and was intended to be of wider extent, and include some plates which I cannot now give.

SYSTEMA NOCTUIDÆ AMERICÆ BOREALIS.

I. THYATIRIDÆ.

Habrosyne Hubn.
Scripta *Gosse.*
Pseudothyatira m.
Cymatophoroides *Guen.*
var. Expultrix *m.*
Thyatira Ochs.
Pudens *Guen.*
Lorata *m.*
Bombycia Hubn.
Semicircularis *m.*
Improvisa *Hy. Edw.*
Leptina Guen.
Ophthalmica *Guen.*
Australis *m.*
Doubledayi *Guen.*
Dormitans *Guen.*
Latebricola *m.*

II. NOCTUIDÆ.

1. *Dicopinæ.*
Eutolype m.
Rolandi *m*
Dicopis m.
Muralis *m.*
Viridescens *Walk.*
Electilis *Morr.*
Depilis *m.*
Thaxterianus *m.*
Damalis *m.*
Copipanolis m.
Cubilis *m.*

2. *Apatelinæ.*
Andela Walk.
Acromyctoides *Walk.*
Platycerura Pack.
Furcilla *Pack.*
Charadra Walk.
Propinquilinea *m.*
Derideus *Guen.*
Dispulsa *Morr.*
Palata *m.*
Raphia Hubn.
Abrupta *m.*
Frater *m.*
Peralia m.
Jocosa *Guen.*
Momaphana m.
Comstocki *m.*
Diphthera Hubn.
Fallax H.-S.
Apatela Hubn.
Occidentalis *G. and R.*
Morula *G. and R.*
Thoracica *m.*
Falcula *m.*
Parallela *m.*
Albarufa *m.*
Paupercula *m.*
Vinnula *m.*
Quadrata *m.*
Tota *m.*
Americana *Harr.*
Dactylina *m.*
Spinea *m.*
Lupini *m.*

Vulpina *m.*
Felina *m.*
Luteicoma *G. and R.*
Distans *m.*
Subochrea *m.*
Noctivaga *m.*
Afflicta *m.*
Connecta *m.*
Harveyana *m.*
Ovata *m.*
Exilis *m.*
Hæsitata *m.*
Dissecta *G. and R.*
Sperata *m.*
Edolata *m.*
Extricata *m.*
Lithospila *m.*
Lanceolaria *m.*
Insolita *m.*
Arsilonche Led.
Henrici *m.*
var. Evanidum *m.*
Copablepharon Harvey.
Absidum *Harvey.*
Album *Harvey.*
Subflavidens *m.*
Longipenne *m.*
Harrisimemna m.
Trisignata *Walk.*

3. *Bryophilinæ.*

Cerma Hubn.
Cora Hubn.
Polygrammate Hubn.
Hebraicum *Hubn.*
Microcœlia Guen.
Fragilis *Guen.*
Diphteroides *Guen.*
var Obliterata *m.*
Bryophila Tr.
Lepidula *m.*
Cyathissa m.
Percara *Morr.*
Chytonix m.
Sensilis *m.*

4. *Noctuinæ.*

Carneades m.
Mœrens *m.*
Citricolor *m.*
Agrotis Hubn.
Badicollis *m.*
Janualis *m.*
Pallidicollis *m.*
Opacifrons *m.*
Perattenta *m.*
Attenta *m.*
Stellaris *m.*
Phyllophora *m.*
Rubifera *m.*
Perconflua *m.*
Rosaria *m.*
Planalis *m.*
Hospitalis *m.*
Viralis *m.*
Esurialis *m.*
Quarta *m.*
Apposita *m.*
Fishii *m.*
Normaniana *m.*
Conchis *m.*
Mirabilis *m.*
Innotabilis *m.*
Washingtoniensis *m.*
Treatii *m.*
Juncta *m.*
Haruspica *m.*
Muscosa *m.*
Invenusta *m.*
Terrealis *m.*
Mercenaria *m.*
Auxiliaris *m.*
var. Agrestis *m.*
var. Introferens *m.*
Perexcellens *m.*
Gularis *m.*
Immixta *m.*
Docilis *m.*
Evanidalis *m.*
Herilis *m.*
Vittifrons *m.*

Insularis *m.*
Costata *m.*
Idahoensis *m.*
Formalis *m.*
Facula *m.*
Emarginata *m.*
Observabilis *m.*
Bimarginalis *m.*
Bicollaris *m.*
Lætula *m.*
Cupida *m.*
var. Brunneipennis *m.*
var. Alternata *m.*
var. Cupidissima *m.*
var.? Orbis *m.*
Variata *m.*
Minimalis *m.*
Placida *m.*
Discoidalis *m.*
Brunneicollis *m.*
Havilæ *m.*
Murænula *G. and R.*
Dolis *m.*
Dapsilis *m.*
Catenula *m.*
Atrifera *m.*
Vernilis *m.*
Euroides *m.*
Milleri *m.*
Vocalis *m.*
Hollemani *m.*
Silens *m.*
Albalis *m.*
Cloanthoides *m.*
Infimatis *m.*
Lagena *m.*
Pluralis *m.*
Pleuritica *m.*
Pitychreus *m.*
Niveivenosa *m.*
Niveilinea *m.*
Olivalis *m.*
Quadridentata *G. and R.*
Cicatricosa *G. and R.*
Ridingsiana *m.*
Lewisii *m.*
Versipellis *m.*
Colata *m.*
Declarata *Walk.*
var. Campestris *m.*
var. Decolor *Morr.*
var. Albipennis *m.*
var. Nigripennis *m.*
Verticalis *m.*
Tessellata *Harris.*
var. Atropurpurea *m.*
Tesselloides *m.*
Strigilis *m.*
Geniculata *G. and R.*
Collaris *G. and R.*
Badinodis *m.*
Bollii *m.*
Atrifrons *m.*
Piscipellis *m.*
Grandipennis *m.*
Perfusca *m.*
Velleripennis *m.*
Pastoralis *m.*
Balinitis *m.*
Friabilis *m.*
Fuscigera *m.*
Brunneigera *m.*
Rubefactalis *m.*
Micronyx *m.*
Fumalis *m.*
Dollii *m.*
Eriensis *m.*
Worthingtoni *m.*
Sublatis *m.*
Munis *m.*
Violaris *G. and R.*
Wilsonii *m.*
Specialis *m.*
Basalis *m.*
Mimallonis *m.*
Gagates *m.*
Catherina *m.*
Circumdata *m.*
Vancouverensis *m.*
Semiclavata *m.*
Gravis *m.*
Vapularis *m.*

Ænepennis *m.*
Nanalis *m.*
Clodiana *m.*
Texana *m.*
Pellucidalis *m.*
Beata *m.*
Cænis *m.*
Nigrovittata *m.*
Trabulis *m.*
Pressa *m.*

Anytus m.

Sculptus *m.*
var. Planus *m.*

Ammoconia Led.

Decipiens *m.*
var. Parentalis *m.*
Distichoides *m.*

Adita m.

Chionanthi *A. and S.*

Eucoptocnemis m.

Fimbriaris *Guen.*

Agrotiphila m.

Montana *Morr.*

5. *Hadeninæ.*

Fishia m.

Euthea *m.*

Copimamestra m.

Occidenta *m.*

Mamestra Ochs.

Purpurissata *m.*
Discalis *m.*
Lubens *m.*
Beanii *m.*
Legitima *m.*
Liquida *m.*
Noverca *m.*
Goodellii *m.*
Vittula *m.*
Farnhamii *m.*
Nevadæ *m.*
Subjuncta *G. and R.*
Atlantica *m.*
Dimmockii *m.*
Bisulca *m.*
Crotchii *m.*
Chartaria *m.*
Defersa *m.*
Bella *m.*
Pensilis *m.*
Vicina *m.*
Acutipennis *m.*
Gnata *m.*
Glaciata *m.*
Cuneata *m.*
Quadrilineata *m.*
Alboguttata *m.*
Comis *m.*
Sutrina *m.*
Lustralis *m.*
Meditata *m.*
Innexa *m.*
Spiculosa *m.*
Ferrealis *m.*
Cinnabarina *m.*
var. Ferrea *m.*
Niveiguttata *m.*
Leucogramma *m.*
Insolens *m.*
♂ *Arietis* m.

Trichoclea m.

Decepta *m.*

Luceria Von Hein.

Delicata *m.*

Hadena Schrank.

Ducta *m.*
Separans *m.*
Occidens *m*
Bridghamii *G. and R.*
Violacea *m.*
Hulstii *m.*
Sputatrix *m.*
Plutonia *m.*
Vultuosa *m.*
Cristata *m.*
Lignicolor *Guen.*
var. Quæsita *m.*
Genialis *m.*
Auranticolor *m.*
Cuculliiformis *m.*

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Vulgaris *G. and R.*
Idonea *m.*
Semilunata *m.*
Discors *m.*
Perpensa *m.*
Cinefacta *m.*
Leucoscelis *m.*
Olorina *m.*
Hillii *m.*
Indirecta *m.*
Tusa *m.*
Tonsa *m.*
Chryselectra *m.*
Charactra *m.*
Genetrix *m.*
Adnixa *m.*
Fumosa *m.*
Longula *m.*
Diversilineata *m.*
Tortilis *m.*
Marina *m.*
Misera *m.*
Cylindrica *m.*
Vulgivaga *Morr.*
Fractilinea *m.*
var. præc.?
Modiola *m.*
var. præc.?
Hausta *m.*
Pseudanarta Hy. Edw.
Crocea *Hy. Edw.*
Flava *m.*
Singula *m.*
Flavidens *m.*
Aurea *m.*
Oligia Hubn.
Chalcedonia *Hubn.*
var. Tracta *m.*
Versicolor *m.*
Fuscimacula *m.*
Perigea Guen.
Epopea *Cramer.*
Cupentia Cram.
Infelix Guen.
Confederata m.
Condica Palpalis Walk.
Iole *m.*
Xanthioides *Guen.*
var. Enixa *m*, pall.
Luxa *m.*
Falsa *m.*
Albolabes *m.*
Loculosa *m.*
Vecors *Guen.*
Lussa m.
Nigroguttata *m.*
Dipterygia Steph.
Scabriuscula *Linn.*
Hyppa Dup.
Xylinoides *Guen.*
Hillia m.
Senescens *m.*
Vigilans *m.*
Algens *m.*
Valeria Germ.
Opina *m.*
? Conserta *m.*
Dryobota Led.
Stigmata *m.*
Arthrochlora m.
Februalis *m.*
Copivaleria m.
Grotei *Morr.*
Oncocnemis Led.
Hayesi *m.*
Dayi *m.*
Mirificalis *m.*
Behrensi *m.*
Levis *m.*
Pernotata *m.*
Glennyi *m.*
Homogena *m.*
Oblita *m.*
Augustus *Harvey.*
Chandleri *m.*
Riparia *Morr.*
Major *m.*
Aqualis *m.*
Curvicollis *m.*
Cibalis *m.*
Gracillima *m.*
Saundersiana *m.*

Occata *m.*
Atricollaris *Harvey.*
Atrifasciata *Morr.*
Griseicollis *m.*
Aterrima *m.*

Homohadena m.

Chorda *m.*
Badistriga *m.*
Vulnerea *m.*
Kappa *m.*
Figurata *Harvey.*
Epipaschia *m.*
Induta *Harvey.*
Incomitata *Harvey.*
Inconstans *m.*
Fortis *m.*
var. ? Picina *m.*

Aporophyla Guen.

? Yosemitæ *m.*

Trichopolia m.

Dentatella *m.*
Ptilodonta *m.*

Pachypolia m.

Atricornis *m.*

Polia Fr.

Acutissima *m.*
Medialis *m.*
Illepida *m.*
Pallifera *m.*
Ædon *m.*
Theodori *m.*
Epichysis *m.*

Hadenella m.

Pergentilis *m.*

Actinolia Hubn.

Ramosula *Guen.*
Stewarti *m.*

Callopistria Hubn.

Strena *m.*

Laphygma Guen.

Frugiperda *A. and S.*

Prodenia Guen.

Commelinæ *A. and S.*
Præfica *m.*

Eupsephopæctes m.

Procinctus *m.*

Conservula m.

Anadonta *Guen.*

Trigonophora Hubn.

Periculosa *Guen.*
var. V-brunneum *m.*

Euplexia Steph.

Lucipara *Linn.*

Brotolomia Led.

Iris *Guen.*

Nephelodes Guen.

Minians *Guen.*
var. Violans *Guen.*

Tricholita m.

Semiaperta *Morr.*
Fistula *Harv.*
Inconspicua *m.*

Admetovis m.

Oxymorus *m.*

Helotropha Led.

Reniformis *m.*
var. Atra *m.*
Sera *G. and R.*

Apamea Tr.

Purpuripennis *m.*
Nictitans *Bkh.*
Juvenilis *m.*
Erepta *m.*

Gortyna Hubn.

Inquæsita *G. and R.*
Cerina *m.*
Rigida *m.*
Cataphracta *m.*
Impecuniosa *m.*
Purpurifascia *G. and R.*
Harrisii *m.*
Speciosissima *G. and R.*
Cerussata *m.*
Necopina *m.*
Serrata *m.*

Ochria Hubn.

Sauzalitæ *m.*
Buffaloensis *m.*

Achatodes Guen.

Zeæ *Harris.*

Macronoctua m.

Onusta *m.*

Euthisanotia Hubn.
Timais *Cram.*
Lathosea m.
Pulla *m.*

6. *Arzaminæ.*

Sphida m.
Obliquata *G. and R.*
Arzama Walk.
Densa *Walk.*
Vulnifica *m.*
Melanopyga *m.*
Diffusa *m.*

7. *Nonagriinæ.*

Nonagria Ochs.
Permagna *m.*
Subflava *m.*
Oblonga *m.*
Tota m.
Armata *m.*
Minorata *m.*
Senta Steph.
Defecta *m.*
Platysenta m.
Atriciliata *m.*
Angustiorata *m.*
Tapinostola Led.
Orientalis *m.*
Ommatostola m.
Lintneri *m.*
Heliophila Hubn.
Oxygala *m.*
Prægracilis *m.*
Patricia *m.*
Bicolorata *m.*
Rubripennis *G. and R.*
Ligata *m.*
Dia *m.*
Lapidaria *m.*
Adjuta *m.*
Farcta *m.*
Adonea *m.*
Flabilis *m.*
Rimosa *m.*
Pseudargyria *Guen.*
var. Callida *m.*
Zosteropoda *m.*
Hirtipes *m.*
Ufeus m.
Satyricus *m.*
Plicatus *m.*
Unicolor *m.*
Sagittarius *m.*
Pteroscia Morr.
Atrata *Morr.*

8. *Scolecocampinæ.*

Scolecocampa Guen.
Liburna *Geyer.*
Eucalyptera Morr.
Bipuncta *Morr.*
Obscura *m.*
Doryodes Guen.
Bistriaris *Geyer.*
Phiprosopus m.
Callitrichoides *m.*
Amolita m.
Fessa *m.*
Cilla m.
Distema *m.*

9. *Nolaphaninæ.*

Nolophana *m.*
Malana *Fitch.*
Triquetrana *Fitch.*
Zelleri *m.*
Labecula *m.*
Adipsophanes m.
Miscellus *m.*
Crambodes Guen.
Talidiformis *Guen.*

10. *Caradrinæ.*

Fotella m.
Notalis *m.*
Caradrina Tr.
Miranda *m.*

Fragosa *m.*
Civica *m.*
Pyrophila Hubn.
Tragopoginis (Linn.).
Triquetra *m.*

11. *Tæniocampinæ.*

Orthodes Guen.
Nitens *m.*
Himella m.
Intractata (*Morr.*).
Tæniocampa Guen.
Agrotiformis *m.*
Virgula *m.*
Furfurata *m.*
Peredia *m.*
Rufula *m.*
Puerilis *m.*
Perbrunnea *m.*
Consopita *m.*
Garmani *m.*
Perigrapha Led.
Normalis *m.*
Muricina *m.*
Behrensiana *m.*
Plusiiformis *Hy. Edw.*
Erythrolita *m.*
Transparens *m.*
Præses *m.*
Crocigrapha m.
Normani *m.*
Xylomiges Guen.
Hiemalis *m.*
Curialis *m.*
Patalis *m.*
Tabulata *m.*
Perlubens *m.*
Dolosa *m.*
Morrisonia m.
Evicta *m.*
var. Vomerina *m.*
Infidelis *m.*
Anchocelis Guen.
Digitalis *m.*
Parastichtis Hubn.
Gentilis *m.*
var. Perbellis *m.*

12. *Orthosiinæ.*

Metalepsis m.
Cornuta *m.*
Pachnobia Guen.
Carnea *Thunb.*
Trichorthosia m.
Parallela *m.*
Pseudorthoria m.
Variabilis *m.*
Pectinata *m.*
Chœphora G. and R.
Fungorum *G. and R.*
Pseudoglæa m.
Tædata *m.*
Blanda *m.*
Decepta *m.*
Zotheca m.
Tranquilla *m.*
var. Viridula *m.*
var. Viridifera *m.*
Cea m.
Immacula *m.*
Calymnia Hubn.
Orina *Guen.*
Trichocosmia m.
Inornata *m.*
Ipimorpha Hubn.
Pleonectusa *m.*
var. Subvexa *m.*
Orthosia Ochs.
Purpurea *m.*
Crispa *Harvey.*
Decipiens *m.*
Ralla *G. and R.*
Euroa *G. and R.*
Inops *m.*
Helva *m.*
Conradi *m.*
Citima *m.*
Cosmia Hubn.
Infumata *m.*

Homoglæa Morr
Hircina *Morr.*
Carnosa *m.*
Glæa Hubn.
Viasica *m.*
Inulta *m.*
Epiglæa m.
Apiata *m.*
Decliva *m.*
Deleta m.
Jodia Hubn.
Rufago *Hubn.*
Eucirrœdia m.
Pampina (*Guen.*)
Scoliopteryx Germ.
Libatrix *Linn*
Xanthia Hubn.
Togata *Esper.*
Scopelosoma Curtis.
Pettiti *m.*
Græfiana *m.*
Moffatiana *m.*
Ceromatica *m.*
Devia *m.*
Morrisoni *m.*
Vinulenta *m.*
Sidus *Guen.*
var. Walkeri *m.*
Tristigmata *m.*
Litholomia m.
Napæa (*Morr.*).
Lithophane Hubn.
Hemina *m.*
Petulca *m.*
Gausapata *m.*
Ferrealis *m.*
Bettumei *G. and R.*
Oriunda *m.*
Semiusta *m.*
Contenta *m.*
Georgii *m.*
Antennata *Walk.*
Cinerea Riley.
Laticinerea *m.*
Grotei *Riley.*
Cinerosa | m.
Unimoda *Lintn.*
Tepida *m.*
Baileyi *m.*
Querquera *m.*
Viridipallens *m.*
Pexata *m.*
var. Washingtoniana *m.*
Thaxteri *m.*
Capax *G. and R.*
Lithomia Hubn.
Germana *Morr.*
Calocampa Steph.
Cineritia *m.*

13. *Cuculliinæ.*

Cucullia Schrank.
Convexipennis *G. and R.*
Montanæ *m.*
Cita *m.*
Serraticornis *Lintn.*
Cleophana Boisd.
Eulepis *m.*
Nyctophæata Smith.
Magdalena *Hulst.*

14. *Eurhipiinæ.*

Ripogenus m.
Pulcherrimus *m.*
Marasmalus m.
Ventilator *m.*
Histrio *m.*

15. *Ingurinæ.*

Ingura Guen.
Declinata *m.*
Præpilata *m.*
Flabella *m.*
Oculatrix *Guen.*

16. *Anomiinæ.*

Anomis Hubn.
Erosa *Hubn.*
Exacta *Hubn.*
Aletia Hubn.
Argillacea *Hubn.*

Hostia *Harvey.*

Pteræthollix m.
Bullula *m.*

Chytoryza m.
Tecta *m.*

17. *Litoprosopinæ.*

Litoprosopus m.
Futilis *G. and R.*

18. *Calpinæ.*

Calpe Tr.
Canadensis *Beth.*

19. *Stiriinæ.*

Hypsoropha Hubn.
Monilis *Fabr.*
Hormos *Hubn.*

Plusiodonta Guen.
Compressipalpis *Guen.*

Basilodes Guen.
Pepita *Guen.*
Chrysopis *m.*

Stiria m.
Rugifrons *m.*
Sulphurea *Neum.*

Stibadium m.
Spumosum *m.*
Aureolum *Hy. Edw.*

Chamæclea m.
Pernana *m.*

Cirrhophanus m.
Triangulifer *m.*

Pala m.
Ptycophora *m.*

Plagiomimicus m.
Pityochromus *m.*
Expallidus *m.*
Tepperi *Morr.*

Acopa Harvey.
Carina *Harvey.*
Perpallida *m.*
Incana *Hy. Edw.*

Neumœgenia m.
Poetica *m.*

20. *Plusiinæ.*

Diastema Guen.
Tigris *Guen.*

Telesilla H.-S.
Cinereola *Guen.*
Navia *Harv.*

Behrensia m.
Conchiformis *m.*

Abrostola Ochs.
Ovalis *Guen.*
Urentis *Guen.*

Deva Walk.
Purpurigera *Walk.*
Paligera *m.*

Plusia Fabr.
Æreoides *m.*
Metallica *m.*
Contexta *m.*
Putnami *m.*
Striatella *m.*
Formosa *m.*
Mappa *G. and R.*
Dyaus *m.*
Labrosa *m.*
Monodon *m.*
Pseudogamma *m.*
Fratella *m.*
Pedalis *m.*
Viridisignata *m.*
Epigæa *m.*
Sarena *m.*
Pasiphæia *m.*
Sackenii *m.*

21. *Heliothinæ.*

Lepipolys Guen.
Perscripta *Guen.*

Anarta Ochs.
Cordigera *Thunb.*
Luteola *G. and R.*
Quadrilunata *m.*

Nivaria *m.*
Subfuscula *m.*
Submarina *m.*
Sympistis Hubn.
Proprius *Hy. Edw.*
Pseudanthœcia Sm.
Tumida *m.*
Dasypoudæa Sm.
Lucens *Morr.*
var. Luxuriosa *m.*
Meadii *m.*
Euedwardsia m.
Neumœgeni *Hy. Edw.*
Xanthothrix Edw.
Ranunculi *Hy. Edw.*
Axenus m.
Arvalis *m.*
Pseudatamila Sm.
Vanella *m.*
Perminuta *Hy. Edw.*
Heliaca H.-S.
Diminutiva *m.*
Heliosea m.
Pictipennis *m.*
Heliophana m.
Mitis *m.*
Heliolonche m.
Modicella *m.*
Melicleptria Hubn.
Celeris *m.*
Pulchripennis *m.*
Villosa *m.*
Persimilis *m.*
Honesta *m.*
Sueta *m.*
var. Californiensis *m.*
Dysocnemis m.
Belladonna *Hy. Edw.*
Melaporphyria *m.*
Immortua *m.*
Prorupta *m.*
Ononis *Fabr.*
Heliochilus m.
Paradoxus *m.*
Heliothis Hubn.
rmiger *Hubn.*
var. Umbrosus *m.*
Lupatus *m.*
Cupes *m.*
Pyrrhia Hubn.
Angulata *m.*
Stilla *m.*
Oxylos m.
Citrinellus *G. and R.*
Alaria Westw.
Gauræ *A. and S.*
Rhodophora Guen.
Florida *Guen.*
Rhodosea m.
Julia *m.*
Derrinia Walk.
Stellata *Walk.*
var. Henrietta *m.*
Rhododipsa m.
Volupia *Fitch* (m.).
Miniana *m.*
Ædophron Led.
Snowi *m.*
Lygranthœcia G. and R.
Marginata *Haw.*
Rivulosa Guen.
Thoreaui *G. and R.*
Saturata *m.*
Separata *m.*
var. Balba *m.*
var. Acutilinea *m.*
var. ? Coercita *m.*
Velaris *m.*
Tertia *m.*
Limbalis *m.*
Acifera *Guen.*
var. Spraguei *m.*
Brevis *m.*
var. Atrites *m.*
Meskeana *m.*
var. Rufimedia *m.*
Packardii *m.*
Mortua *m.*
Nobilis *m.*
Eulcucyptera m.
Cumatilis *m.*
Tennescens *m.*
Tricopis m.
Chrysellus *m.*

Hulotia *Zepper.*
Aleucis *Harv.*
Pippona Harv.
Bimatris *Harv.*
Antaplaga m.
Dimidiata *m.*
Sexseriata *m.*
Grotella Harv.
Septempunctata *Harv.*
Dis *m.*
Oxycnemis m.
Adrena *m.*
Triocnemis m.
Saporis *m.*
Pseudacontia Sm.
Crustaria *Morr.*

22. *Acontiinæ.*

Trichotarache m.
Assimilis *m.*
Tarache Hubn.
Flavipennis *m.*
Abdominalis *m.*
Lanceolata *m.*
Angustipennis *m.*
Sutrix *m.*
Binocula *m.*
Virginalis *m.*
Cretata *G. and R.*
Terminimaculata *m.*
Chamyris *Guen.*
Cerintha Fr.
Xanthodes Guen.
(?) Buxea *m.*
Trileuca m.
Rectifascia *m.*
Gulnare *Streck.*

23. *Eustrotiinæ.*

Lithacodia Hubn.
Bellicula *Hubn.*
Annaphila m.
Diva *m.*
Divinula *m.*
Decia *m.*
Depicta *m.*
Danistica *m.*
Eustrotia Hubn.
Malaca *m.*
Mitographa *m.*
Secta *m.*
Concinnimacula *Guen.*
var. Parvimacula *m.*
Synochitis *G. and R.*
Musta *G. and R.*
Retis *m.*
Distincta *m.*
Caduca *m.*
Mariæ *m.*
Aeria *m.*
Dividua *m.*
Escaria m.
Clauda *m.*
Euherrichia m.
Monetifera *Guen.*
Thalpochares Led.
Ætheria *m.*
Orba *m.*
Fortunata *m.*
Perita *m.*
Tripudia.
Quadrifera *Zell.*
Flavofasciata *m.*
Basicinerea *m.*
Lixiva *m.*
Gyros Hy. Edw.
Muirii *Hy. Edw.*
Spragueia m.
Magnifica *m.*
Plumbifimbriata *m*
Pardalis *m.*
Funeralis *m.*
Sordida *m.*
Guttata *m.*
Inorata *m.*
Pruva m.
Fasciatella *m.*
Obsoleta *m.*
Georgica *m.*
Apicella *m.*

Azenia m.
Implora *m.*
Edentata *m.*
Prothymia Hubn.
Coccineifascia *m.*
Rosalba *m.*
Orgyæ *m.*
Plana *m.*
Xanthoptera Guen.
Nigrofimbria *Guen.*
Clausula *m.*
Exyra m.
Semicrocea *Guen.*
Fax *m.*
Rolandiana *m.*
Lepidomys Guen.
Irrenosa *Guen.*
Metoponia Dup.
Obtusa *H.-S.*
Perflava *Harv.*
Galgula Guen.
Hepara *Guen.*
Subpartita *Guen.*

24. *Hyblæinæ.*

Hyblæa Fabr.
Puera *Fabr.*

1. *Dicopinæ* m. In this section are grouped genera with the head sunken, the squamation rough or thick, the abdomen tending to be weak and plump, as in the *Apatelinæ*, the tibiæ unarmed except by a strong claw on anterior pair, the ocelli present, the male antennæ thick and stoutly pectinate, the eyes naked and lashed, the labial palpi short, the tongue moderate, the chrysalis hibernates, and the moths appear early in the year. As to the ornamentation it is typical in *Dicopis*, and agrees with the *Hadeninæ*. I believe the group to be really close to the latter, and would bring the genera either before or after that group. It does not appear to be represented in Europe. As an instance that natural structural characters are only of subordinate value in arranging the family groups, I would instance the genera *Dicopis*, *Copivaleria*, *Oncocnemis* and *Basilodes*, all have naked eyes, unarmed tibiæ with a claw on anterior pair, yet we cannot associate them in a single group, their general appearance and form is so diverse. *Eutolype* is singular for a small central chalybeous tuft of thoracic scales (easily overlooked and removed when the moth is pinned) only noticeable also in *Tolype* and *Eudryas;* there is a somewhat analogous posterior tuft in *Oxycenmis*. *Copipanolis* is a very singular Bombyciform genus, reddish in color with variably thick median lines, narrower in the female, found from Massachusetts to Texas. There is a faint resemblance to the European genus *Panolis*, but on the whole, I think, a mere analogy.

2. *Apatelinæ* m. This is Boisduval's *Bombycoidea*. The genera are more or less like *Notidontidæ* or *Dasychirinæ* as to moth and larva. The wings are even, the body plump, often the males have pectinate antennæ, though the typical genus was then simple. The larvæ are usually hairy, bristled and bizarre in appearance. *Apatella Funeralis* has club-shaped hairs, and represents in our fauna the European *A. Alni*. *Raphia* is represented by two species, of which the neuration of *Abrupta* seemed to me to agree with that of *R. Hybris*, the European type of the genus which I have never seen. *Charadra* has hairy eyes, and is nearly related, perhaps not distinct. *Audela* and *Platycrura* seem to me related. The term *Diph-*

thera is first used for the European *Aprilina* with which our *D. Fallax* is congenerical, the term *Moma* is incorrectly used for this latter form. For the European *Ludifica*, the term *Trichosea* must be used. The genera *Raphia*, *Charadra* need a re-examination, which now that several species are described can be profitably undertaken. *Apatela* falls into sections which may in some cases have a generic value.

3. *Bryophilinæ* m. The typical genus has flattened scales on the thorax, and is of slight form, the larva feeding on lichens as observed in Europe. The immature stages of our species are not known. *Cyathissa* differs by its narrow form, and an excision below apices of primaries. *Chytonix* is somewhat stouter, with Hadeniform ornamentation; the type was described by Guenée under *Apamea*, but appears to me to be the male form of *Bryophila Palliatricula* Guen. The thorax is scaled; the species are brown with a white sub-median spot attached to t. p. line, or the median field shaded with white. A new title may be necessary for *Cora*, which in many respects is near *Trisignata*. Perhaps only the three last genera belong strictly to this group.

4. *Noctuiinæ* m. This group I place here following Lederer; it seems to me really lower than the *Hadeninæ* and to have affinities with the *Orthosiinæ*. It comprises the typical genus *Agrotis*, with naked, unlashed eyes, untufted abdomen, spinose tibiæ and smoothly haired thorax with the normal Noctuid markings. I have lately very fully discussed the genus in the pages of the Canadian Entomologist, to which paper I refer the student. *Carneades* differs by the mucronate clypeus; *Anytus* by the lashed eyes; *Agrotiphila* by the constricted eyes; our species of *Ammoconia* by the ridge on the thorax, they may not be congeneric with the European as they seem slighter, but their essential character refers them here. Finally, *Eucoptocnemis* is used for a species of Guenée's described by Mr. Morrison, which differs in the claw to fore tibiæ, and *Adita* is employed for a large species with spinose middle and hind tibiæ but unarmed fore tibiæ provided with a stout claw. *Puchnobia* is referred by Lederer to the *Orthosiinæ*.

The very numerous species of *Agrotis* described by me are here again gone over as far as practicable, and I believe I have retained none but valid species. The type of *Milleri* (named for the poet), is in the fine collection of Mr. Henry Edwards, and disputes with *Hilliana* and *Circumducta*, the claim of the handsomest species among many very pretty but some plain and even ugly (*Cochranii*) forms. I have referred to *Cupida*, all the forms which are possibly varieties, but which no one at first could be blamed for considering distinct. *Alternata* is at least a good variety; I have seen some reddish specimens approaching *Cupida*, but still with pale terminal field. *Cupidissima* is represented by specimens, tending to brownish in Mr. Neumœgen's extensive collection. *Brunneipennis* is applied to small specimens with obliterate markings, very deep red-brown varying to bright orange red. *Orbis* has the orbicular minute, and may be distinct. On the other hand, *Bicollaris*, small with a band on the collar, and *Variata*

much shaded with white are without any doubt on my mind valid species. I have united under the name *Declarata*, all the distinguishable forms allied to the Western type. I think that some of these may turn out distinct, in particular *Albipennis* with whitish secondaries in both sexes, while *Tricosa* and *Subgothica* may be varieties, this cannot, I think, be predicated of *Herilis*. The only yellow-winged *Agrotis* we have, my *Gilvipennis*, is now held to be the same as *Chardinyi* from Siberia. Among our showiest species are *Mimallonis*, *Bimarginalis*, *Conchis*, *Mirabilis*, *Grandipennis*, *Mireivenosa*, *Beata* and *Dollii*, chiefly from the West.

5. *Hadenina* m. This group has the eyes full, naked or hairy, the palpi well developed, the second joint pilose and long, ocelli, the body hirsute, and often tufted on the dorsal line, the ornamentation normal. *Fishia* has the tibiæ spinose, *Oncocnemis*, *Copimamestra* and *Copivaleria* have a claw on front tibiæ, otherwise the tibiæ in this group are unarmed. *Polyphænis herbacea*, described by Guenée, is unknown to me. *Mamestra* has hairy eyes; I include in it the species of *Dianthœcia* which have the ♀ ovipositor exserted. *Copimamestra* includes the European *Brassicæ*, and has a tibial claw. *Hadena* has naked eyes, otherwise agreeing with *Mamestra*. *Oligia* is used for very slight species referred by Guenée to *Celæna* in part; they are glistening and the usual tufts are obsolete. *Perigea* also wants the thoracic tufts except behind the collar, the eyes are naked, the vestiture mixed with scales, silky. The European species of *Dryobota* and *Valeria* have not been examined by me and our North American forms needs to be compared with these; the same is true of the species referred to *Aporophyla*, and in part of *Polia*. In this genus the last three species form a distinct group; *Pullifera* seemed to me a true *Polia*; while *Illepida* is aberrant, with pectinate ♂ antennæ and approaches *Pachypolia*. I have discovered a true *Callopistria* in Florida; the species formerly referred to this genus I have removed under *Euherrichia* to a later group. *Admetoris* has hairy eyes and extruded ovipositor, and seems to me best placed near *Nephelodes*. *Tricholita* has the ♂ antennæ pectinate, the vestiture longer, the apices pointed, the size smaller. *Ochria* has the clypeus mucronate, otherwise the species are similar to the forms I arrange under *Gortyna*. *Maeronoctua* approaches the Nonagrians, while as to *Lathosea* I am doubtful of its true affinities. The moth is hirsute with retracted head, and has some resemblances also to the Nonagrians. The Hadenoid moths belong principally to European genera, and should be studied with these in hand. After a very diligent study of European authorities, I find it impossible to arrive at a certainty without the types of European genera to consult. Our fauna is remarkable for the numerous species of *Oncocnemis*. Among the American genera *Hadenella* is to be noted for the clypeal horn and *Lussa* for the long untufted abdomen and narrow wing, looking like a Pyralid; the genus is from the tropical faunal province of southern Florida, and maybe West Indian also; I am not certain that it is rightly placed, it has a certain resemblance to *Perigea*. It is difficult to separate some of the species

I have placed under *Gortyna* from *Orthosia*, and perhaps when the early stages are known, and the species more minutely studied, some changes will be found necessary. The principle changes from my classification, however, will probably be made with *Polia*, *Dryobota*, etc.

The true type of *Apamea*, is, I believe, *Nictitans*. The genera *Gortyna* and *Hydræcia* have the same type, *Micacea*. I have employed the genus *Ochria*, used solely for *Flavago* in the "Verzeichniss," for our two species which have also a clypeal thorn. This character may be trivial, but it is everywhere used, and cannot be rejected arbitrarily. As with *Sphida*, it separates here species I would gladly keep united. From the pectinate antennæ (the opposite of *Nephelodes*), the thoracic tuft and the general contour I would keep *Tricholita*, with its three species, distinct from *Nephelodes;* the white reniform is characteristic, and allies the moths to *Nictitans*. I have a note to the effect that *Semiaperta* had been described previously by Walker, but cannot at the moment find the citation. With some few other changes, the fewer the better, this will be made whenever the British Museum collection is compared with our material. If the idea of justice or injustice can be held to be properly associated with matters of this kind, it may be held unjust to restore any of Dr. Walker's names where recognition is a matter of impossibility without reference to the type. This is the case with about three-fourths of his descriptions in the *Noctuidæ*. But, disagreeing with Professor Riley, Mr. Walker's description of *Xylina Antennata* and *H. Signosa* are not of these, and the moths are referred moreover to the right genus.

6. *Arzaminæ* m. This remarkable group has aquatic larvæ, with spiracles, as discovered by Prof. Comstock, and the larvæ may be taken in the leaves of pond lilies and other water-plants and swimming free in the water. They inhabit ponds from Canada to Florida, and the chrysalis may be found under stones and logs on the margin. *Obliquata* is found in Niagara river, the pupa having occurred on Strawberry island. *Vulnifica* has been found at Ithaca, and what is probably a variety, with the anal tuft blackish, in Florida lakes. *Diffusa* has been found in Maine and also collected by Mr. Moffat in Canada. The moths are very thick-bodied and heavy insects, remarkable for the large female anal tuft, like that of some forms of *Bombyx*. *Sphida* has the clypeus mucronate, *Arzama* unarmed; the difference is very slight and unessential.

7. *Nonagriinæ* m. This, to me the most interesting subfamily of the group, is equivalent to the *Nonagriadæ* of Dr. Harris. The eyes are full, naked or hairy, the thorax smoothly haired, rarely with a crest, the abdomen untufted. The wings are rather narrower and longer than usual, most often of a pale buff, or the color of dried reeds. The moths are found by the sea-coast, or in marshy places quite often, and the larvæ live on grasses. *Nonagria* has naked eyes and a large clypeal protuberance; one species from Florida is of unusually large size. I class here *Tota*, which has somewhat ovate fore wings and a triply pointed clypeal horn; it resembles *Senta* in shape of wing, but the ornamentation is hadeniform. *Tapinostola*

has one undoubted American species, but I am doubtful that I have correctly referred *Senta Deflecta*, of which I have given a figure (which in some copies of my Plate is colored). My genus *Ommatostola* has been examined by Dr. Speyer, and found to be valid as compared with the type of certain European genera not known to me in nature. The moth *O. Lintneri* (the "Dune Wainscot") occurs on the shores of Long Island. *Heliophila*, the typical genus, has hairy eyes and smooth clypeus, in *Ommatostola* the naked eyes are lashed, and the moth is larger than any of our species of *Heliophila*. Following the law of priority, I have adopted this pretty generic name instead of *Leucania*, which latter is proposed by Ochsenheimer without diagnosis while he quotes *Heliophila* of Hubner as synonymous. Our species are very pretty. *Rubripennis* is beautifully shaded with pale red; *Patricia* is a lovely little Western form with a silvery white stripe; a few are obscurely marked and difficult to separate, but all are very interesting. *Unipuncta* (the "Army Worm") is a very destructive species in the East; *Pallens* is also European. The eyes are hairy, the body smoothly haired, the fore wings rather narrow and tending to be pointed at apices.

The genus *Zosteropoda* is remarkable for the long hairs on secondaries above and the tufted legs. *Ufeus* is an aberrant flat form, by the form of the wings referable here, but resembling *Agrotis* in the spinose tibiæ. *Pteroisca*, of which I have seen but not examined the type, is a rough, rather odd-looking insect superficially resembling *Ufeus*, but which may not belong here. I do not know *Thaumatopsis longipalpus* Morr., nor *Monodes nucicolora* Guen., the latter may be the same as *Oligia Paginata* of Morrison. Under *Leucania* Guenée, without studying the structure of the eyes, has classified such a dissonant species as *Pseudolimacodes Littera*, probably misled by its color resemblance to some aberrant European *Heliophila*. A number of his species are not known to me, and the synonymy may be disturbed when these and the British Museum forms are accurately known.

3. *Scolecocampinæ*. I first in the North American Entomologist showed the relationship of *Scolecocampa*, *Eucalyptera* and *Doryodes*, uniting the two former which are certainly very little different. The body is slender, linear, the palpi long, the legs long, slender, and unarmed, the fore wings pointed. The ornamentation tends to the development of a central stripe tapering to apices. There is certainly a species of *Doryodes* figured by Geyer, which may or may not be our *acutaria*, but seems to me that species. Guenée refers the moth to the *Geometridæ*, but is corrected by Clemens, who takes occasion to sharply review Gueneé's whole work in a criticism which has become celebrated from the notice taken of it in Europe. Zeller refers *Phiprosopus* also to the *Geometridæ*, but I detected ocelli, and the neuration being also Noctuidous I referred the moth originally to the present family and as allied to *Calpe*. I think now the moth is best placed next to *Doryodes* from its similar form, but it is not without resemblances as to extra European genera which seem related to *Calpe*.

My paper, which is earlier than Zeller's, was published while I was in the South, and the generic name was mis-spelled *Phyprosopus*, how the error occurred I cannot now say; I derived the genus from *philo* and *prosopus*, shortening the first word from the undue length of the combination. I am led here to review the few cases where my names were misprinted so far as noticed by me. In all cases I made the correction as soon as possible, and in the case of the *Pluria* in the same volume.

Phiprosopus Callitrichoides *as* Phyprosopus Callitrichoides.
Phisia Viridisignata *as* Plusia Viridisigma.
Perigea Sole *as* Perigea Scole.
Hadena Perpensa *as* Hadena Perpenoa.
Oncocnemis Gracillima *as* Oncocnemis Gracillinea.
Heliochilus Paradoxus *as* Heliocheilus Paradoxus.

9. *Nolaphaninæ* m. The genus *Nolaphana* was considered a *Tortrix* by Fitch, and a Lithosian by Zeller. I detected ocelli, and was disposed to consider the moth a Noctuid, which Zeller agreed to, and figured the neuration. Three species are known to me in nature which differ somewhat in structure; *Malana* has pectinate antennæ, while *Zelleri* has them simple, and in other respects comes nearer my genus *Acliprophanes* which has a posterior thoracic tuft and longer, Caradrina-like wings, whereas in *Nolaphana* the wings are somewhat fuller and rounded, and the moth looks not unlike a *Nola*, from which ocelli, form of labial palpi and neuration separate it. However, I found vein 5 much more removed from 4 than usual, in a preparation of *Malana*, and perhaps we may not have the best location for the moth yet. *Crambodes* looks a little like the European *Axylia Putris*.

10. *Caradrinæ*. This group contains genera with smooth vestiture, untufted, often flattened abdomen and somewhat narrow palpi. The moths are closely allied to certain Hadenoid genera, and the material arranged under *Caradrina* is possibly not consonant. *Fotella* resembles in appearance the species figured by Herrich-Schæffer as *Bryophila Teratophora*. It is more robust, the fringe on hind wings longer, and the moth seems related to *Acosmetia*. Our species of *Pyrophila* are fewer than the European. The moths all have a greasy or silky look, and are fond of hiding under dead bark, where I have found *Pyrophila Pyramidoides* in numbers associated with *Agrotis Clandestina*.

11. *Tæniocampinæ* m. The forms here grouped have as a rule hairy eyes, retracted head, unarmed tibiæ, and hairy or woody vestiture. They are brown in color and usually hibernate as moths. *Orthodes* and *Himella* are silky, like the preceding *Caradrinæ*, *Tæniocampa* contains species which resemble *Agrotis* in look, and have untufted rather weak abdomen and thick vestiture; *Incerta* inhabits Europe and America; some of the forms are rather slight and difficult to separate from *Dianthœcia*, Perigrapha has a medial ridge; *Crocigrapha* a small tuft behind the collar; *Xylomiges* is something like *Lithophane* in form of thorax; *Morrisonia* has

simple antennæ with ornamentation recalling *Cloantha*; *Anchocelis* has naked eyes with the clypeus mucronate, our species is much smaller and differs slightly from the European type; *Parastichtis* (*Dyschorista* Led.), has naked eyes and exserted ♀ oviduct, with somewhat the form of *Dianthœcia*.

12. *Orthosiinæ* m. The numerous genera grouped here seem to fall in between *Tæniocampa* and *Cucullia*. The moths hibernate, as in the former group; they are colored yellow and brown like the autumn leaves in which they hide, and among them may be found some of our handsomest insects. The eyes are naked, the body as a rule untufted, tending to be flat, the ovipositor is concealed. *Metalepsis* has spinose tibiæ, sunken head, pectinate male antennæ, a hollowed out collar, in front discolorous, untufted thorax, short untufted abdomen, naked, lashed eyes. The moth has probably a European congener. *Pachnobia Carnea* has a more woolly thorax, the collar straight; it it found in richly colored varieties on Mount Washington and in Labrador; both these genera have resemblances to preceding group. The ensuing genera have also spinose tibiæ. *Trichorthosia* has hairy eyes and sharply pointed wings. *Pseudorthosia* to the appearance of Orthosia has spinose tibiæ. *Choephira* is broader-winged with stoutly pectinate antennæ, and in the body parts resembles *Zotheca*. *Pseudoglæa* has a flattened abdomen, and appears related to the European *Mesagona*. *Cea* is wide winged, slight and mealy scaled, with naked eyes and unarmed tibiæ; *Calymnia* differs by the smooth front. *Trichocosmia* with similar habit has shortly-haired eyes. *Ipimorpha* (= *Plastenis*) has straight costal margin and sharp apices. The typical *Orthosiæ* much resemble *Hadena*; they are yellow and brown and the genus contains three stout species. *Conradi*, *Lutosa* and *Citima* which would be taken for *Hadenæ* with untufted abdomen. *Cosmia* is longer winged, and our species may be the same as the European *Palæacea*. *Homoglæa* has pectinate antennæ; *Glæa* simple antennæ and untufted flattened body; *Epiglæa* has a thoracic ridge. *Jodia* resembles *Trichorthosia* in shape of wings with naked eyes; the species has sharply pointed wings, and is red in color, and prepares us for *Eucirrœdia* with uneven produced external margin, and *Scoliopteryx* with angulate wings and exaggeratedly tufted flattened body, the tufts like *Eurhipia* which the moth approaches in color and pattern, the flattened body like *Lithophane*. *Scopelosoma* has a flattened body with a small tuft behind collar and even outer margin; our species are numerous, in part variable, whether all strictly belong here is a question I am disposed to be pretty confident about, but *Pettiti* and the yellow forms incline to *Xanthia*. Our species of *Lithophane* are numerous; *Pexata* may be the same as *Ingrica* and *Thaxteri* is regarded as a geographical modification of the European *Conformis*. Till the stages are all known and compared, it is safer to keep our forms under separate names; they should not be united except under complete evidence, judging from what we know of *Occidentalis* for instance, where the larvæ are so distinct. I incline to believe *Lithomia Germana* is not different from

the European *Solidaginis;* the genus has a tuft behind collar; also our *Calocampa Impera* is closer to the European *Vetusta* than I once thought it to be; *Calocampa Cinerilia* is found across the Continent, and is decidedly a different species from either of the European; the same (as to distinctness) is true of the prettier *C. Curvimacula* from the East. In this group *Carnosa* is beyond doubt the handsomest species; even the egg laid in the fall on maple leaves, is of a rich wine-red color. There is a very interesting study opened by the colors of the moths of this group which blend with the ripening leaves among which they hide. Mr. Moffat, a most painstaking observer, has beaten fresh specimens of several *Scopelosomæ* out of oak leaves, in particular *S. Græfiana*, *S. Moffatiana* and the deeply red *S. Ceromatica*, with its waxy chalybeous shadings, have been captured in this way beautifully fresh.

13. *Cucullinæ* m. The wings are long and narrow, the hind wings reduced in size. The eyes are naked. The antennæ simple, except in *C. Serraticornis*, an anomalous species from the Western coast. The collar is hood-shaped; the body cylindrical, heavy, long and tufted on the dorsum of abdomen which much exceeds the secondaries. *Cucullia* is represented by but few species in comparison with the European, yet all the groups seem represented in our fauna, in which *C. Convexipennis* comes nearest to the European type of the genus. *Cleophana* is represented by two species which have a claw on fore tibiæ, the collar hood-shaped, and the general appearance more like *Cucullia* than the European species. *C. Eulepis*, is a handsomely marked species; *C. Antipoda* was erroneously described as a *Cucullia*. The genus *Nyctophæata* was described by me almost simultaneously as a Heliothid under the name of *Epinyctis*. The naked lashed eyes, the hairy vestiture, the absence of a hood-shaped collar, the sunken head, the truncate, thickly spined tibiæ are all Heliothid characters, and bring the moth near to *Grotella* and allied genera. Its describer excludes it from the Heliothians, and does not indicate its position. After seeing a very fine specimen of the beautiful moth in Mr. Neumœgen's large collection I can only place it here from the long narrow wings and stout body; but it contradicts the main features of the group so much that the form alone unites it, and my original position for the moth may finally be found the most natural. The Rev. Mr. Hulst's paper is, I find, dated two months before my own in "Canadian Entomologist" so that my *G. Notatella* has to be dropped for *N. Magdalena*. The moth is among the most beautiful and elegant of the family.

14. *Eurhipiinæ* m. This group agrees with *Cucullia* in the small hind wings. The genus *Ripogenus* is close to the European *Eurhipia*, but differs in detail in the shape of primaries and tuftings of the body. The moth is provided with two terminal abdominal tufts, one on each side, and is tufted along the dorsal line, with longer tufts on the basal segments above. The moth is of a beautiful brownish-red of various shade, with a bluish patch on median field below enclosing yellow dots. Apices shaded with bluish-white; two superposed dots in place of reniform; transverse

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lines pale, irregular; the terminal narrow field and the sub-basal field of a deep rich brown. Hind wings white at base, with a black subterminal shade band followed by a terminal rich brown edge. The margin is angulated on both wings. The other genus *Marasmalus* is narrower bodied, and has the remarkable faculty of holding the wings when at rest like a fan. The two species occur from Maine to Texas; the larger and handsomer *M. Ventilator* is colored like *Ripogenus;* the other is darker and more obscurely tinted, and apparently not uncommon. I took the generic name of *Pulcherrimus* from the Indian, as its colors and ornamentation lent themselves to my fancy as being like the work made by our North American Indians; I did not know then, twenty years ago, that it had a near ally in southern Europe. The names in the other genus are suggestive of the fan-folded wings, which my friend Sanborn likened to those of *Tettix*, and the way in which the moths seem suddenly to disappear. *R. Pulcherrimus* is one of our handsomest Noctuids of this division of the family. I do not think the European fauna has anything prettier than our *Agrotis Hilliana, A. Circumdata, Oncocnemis Atriafasciata, Homoglæa Carnosa, Nyctophæta Magdalena, Ripogenus Pulcherrimus, Rhodosea Julia, Rhodophora Florida, Euleucyptera Cumatilis. Adonisea Pulchripennis, Dasypoudæa Lucens* and *Meadii*, while in the Plusias, those brilliant gems of color, our *Plusia Mappa* is hard to beat.

15. *Ingurinæ* m. The genus *Ingura* is characterized by the antennæ of the male being pectinated at base, the pectinations decreasing suddenly at tip. This form gives the genus a notodentiform look, which Mr. Walker has availed himself of to classify some of our species among the Bombyces. The abdomen is cylindrical, the wings rather narrow and the rounded secondaries are rather small. There is thus a certain resemblance to the preceding groups. Hubner figures a species, which I have not made out, in the "Zutraege," and this seems the earliest notice of any species. The colors are black and dingy, and the ornamentation offers a certain resemblance to *Abrostola*. But *Oculatrix* is an exception, the species having pinkish eye-like markings on the fore wings, and being a showy little insect. In structure it cannot be doubted the genus stands next to *Marasmalus*.

16. *Anomiinæ* m. This subfamily is characterized by the large naked eyes, the smoothly scaled body, tapering abdomen and close silky vestiture. The wings tend to be wide and perhaps *Eulepidotis* belongs here. The larvæ are half-loopers and approach the *Plusia* type. *Anomis* has the wings angulated, and the type *Erosa* is colored not unlike *Xanthia;* the larva has an additional pair of feet developed as compared with *Aletia*. In a study of the false or abdominal feet of caterpillars, I find that there is always some indication in the Noctuid genera which have the superior pair aborted, of the position of these feet, and that the discontinuance of use and the consequent arching of the body at this point is very gradual. *Aletia Argillacea*, the cotton worm moth, has been studied by me in the South. It has undoubtedly affected a lodging with us during the latter

part of the last century, owing to the cultivation of cotton upon which it feeds. It came every year with the zoölogical wave which follows the rising thermometer and the extension of summer over the northern part of our Continent. I discovered that the moth hibernates with us (where it occurs) as a moth, and that it gradually proceeds northward, breeding as it goes, until in the early fall months it has passed the area of cotton growing, and is found in Maine and Canada in the months of September and October. In the North it is very probable that it has found a substitute food-plant, though I do not know it, upon which the final brood is matured. But I found out that it was winter-killed over a large region, or surviving, the wintering moths failed to make a spring brood. How far North this state of affairs is complete is not yet ascertained.

To resume my remarks on the *Anomiinæ*. *Pterætholix* has the male primary provided with a blister-like expansion, and the male of the broader-winged *Chytoryza* has a smaller one. It is here that the wings, being entire, and broadening, tend to resemble the *Ophiusinæ*, and make it likely that the large naked-eyed and smoothly-haired *Eulepidotis* belongs more naturally in this subfamily. The body structure is very similar in all the genera here discussed and its type, once apprehended, is easy of detection. The head is broader and freer than in the Drasteria-like group with which I precede *Catocala* and allies. We have at least two species of *Aletia;* the second a Texan form which may have also a more southern parentage. In form the genus *Aletia* is more typical of the group than *Anomis* with its angulated wings.

17. *Litoprosopinæ* m. This group has the terminal joint of palpi elongated, and resembles *Plusia*, differing by the more robust and untufted body. The eyes are naked; tibiæ unarmed. The wings are long and without the broadening outwardly, and the tooth at anal angle which characterizes the three next groups. *Litoprosopus* is a tropical form, and Professor Pœy describes a species, *L. Hatney*, from Cuba. Our form is found in Florida.

18. *Calpinæ* m. We have only one genus which is equivalent to the European, and in fact our single species may not be different from *Thalictri*. I do not know *Hemiceras Cadmia* of Guenée, nor whether it really belongs to the present group.

19. *Stiriinæ* m. This group is characterized by rather weak body-parts, the thorax short, having the tegulæ often deflected at the tips, the collar a little relieved, the abdomen untufted, the ovipositor prominent, the wings widening outwardly, and often with a projection at anal angle, the fore tibiæ with a claw, the palpi weak and with small third joint, conical and more prominent in *Basilodes*. As a group it oscillates between *Calpe* and *Plusia* in shape of wing and ornamentation, this being sheeny or metallic quite often, in armature of tibiæ and in appearance (*Plagiomimicus*, *Acopa*) it presents an occasional resemblance to the *Heliothinæ*. The palpi differ from the *Plusiinæ* as also the untufted abdomen and the improminent head. I have lately reviewed the genera in "Canadian Entomolo-

gist." The perfect insects are fond of flowers and one (*Cirrhophanus*) appears to be an internal feeder in stems or capsules as a larva.

20. *Plusiinæ* m. The head is more prominent, the third palpal article longer, and the body tufted on the dorsal line. These tufts are prominent in *Plusia*, and there is an exaggerated tuft, fan-shaped, on the abdomen in *Behrensia*, a genus which is nearest to *Abrostola*. *Diastema Tigris* has been sent to Mr. Hy. Edwards from Florida, and seems generically distinct from *Telerilla;* I have not been able to examine it carefully. The species of *Plusia* hover over flowers in the evening like *Sphingidæ;* a few species, *Ni*, *Precationis*, *Dydus*, *Verruca*, I have found active in the daytime, as are several species in the next group. Our species are both numerous and beautiful, but a little darker and richer-colored, less metallic perhaps, than the European. Most interesting are two forms, *Thyatiroides* and *Formosa*, which are mimetic of the genera *Thyatira* and *Leptina* respectively; a curious circumstance when we reflect that *Thyatira* was placed near *Plusia* by certain early authorities.

21. *Heliothinæ* m. The abdomen is conical, untufted, the vestiture hairy, the head usually retracted, the antennæ simple, ocelli present, eyes naked or hairy, often narrowed or constricted, the tibiæ armed, the anterior tibiæ shortened. The colors are bright and pretty, and the species frequent flowers; in the closing blossoms of *Œnothera Biennis*, as described by Prof. Kellicott, who has watched the species in all stages, the moth of *Rhodophora Florida* conceals itself, flower and moth being of the same colors. My arrangement of the genera commences with the nine typical forms *Heliothis* and the genus *Melicleptria*, which I have separated from *Heliothis*, and closes with the usual paler, white genera which show an approach to the following Acontians. As I have shown, I recognized, in 1874, the probable large extent of my genus *Lygranthœcia*. I kept, however, certain forms distinct upon modifications of tibial structure, leaving the responsibility of certain genera with Guenée. But any student with the microscope in hand, and my remarks before him, could have come to the conclusion now reached by Mr. Smith, with a show of originality which is wanting in fact. Mr. Smith unites my species of *Tricopis*, *Euleucyptera* and *Schinia* with *Lygranthœcia*, for which genus he keeps the term *Schinia*, a name which I alone had "resurrected" for the species described by Hubner, thus destroying my connection with the genus which is essentially my work. These do, in fact, present but slight modification of tibial structure, the changeable nature of which is shown by an excellent plate furnished by Mr. Smith, who, from a comparison of all accessible types, arrives at conclusions which, as a rule, I feel bound and glad to accept. But I believe he goes too far in sinking *Tricopis* and making *Euleucyptera* synonymous. I also believe that *Tertia*, which I had described under *Tamila* (under a mistaken view of the characters of that genus which Mr. Smith now corrects), will prove, with *Cupes*, generically distinct. I refer to some points in the generic descriptions given in this

paper, and now only notice the most prominent characters of certain of the genera.

Rhodosea differs from *Alaria* by the fore tibiæ having two terminal claws, else unarmed; these claws are on each side at the extremity of joint; the other two tibiæ are unarmed, although in my first notice I described these tibiæ as sparely pilose. The genus is remarkable for the apparent slight exsertion of the infra-clypeal plate at the middle, the shape of wings, palpi, give comparative characters to separate the roseate, most delicately colored moth from our Eastern genus *Rhodophora*. This last I keep distinct from *Alaria*, the palpi, colors and pattern of the moth seem to me sufficiently modified as to warrant a different term. I draw in *Porrima* (proposed for *Ovia*), a term which I employed for *Sanguinea*, a moth to which *Regia* is allied, as not distinct enough from *Lygranthœcia*, and, except as to the points here discussed, accept Mr. Smith's conclusions. As to *Cupes*, it is admittedly out of place in *Lygranthœcia*, and I keep it in *Heliothis*, to which it is at least as strongly allied, for the present. I used the narrowed eyes to separate certain genera, and this character is adopted by Mr. Smith, who finds it of great value. It led me to classify *Agrotiphila* in this group, and near *Anarta*. In this latter genus are one or two species (*Submarina*, etc.), in which the hairy eyes are not ovate but full, but which from the untufted abdomen and general aspect and ornamentation I cannot refer to *Mamestra*. *Oxycnemis* is a bright gray moth, looking a little like a species of *Charadra* or even a *Dianthœcia capsularis*, which has short front tibiæ terminating in a single claw, and a posterior thoracic tuft of shining curved scales. It is thus allied to *Triocnemis*, which has the shortened tibial joint of the fore feet also corneous, but tridentate, a posterior thoracic tuft, of which the scales are similar, while the moth recalls in ornamentation the European genus *Calophasia*. *Derrima*, placed by Walker in the *Acontidæ*, which led me to overlook this description, has one pretty species *Henrietta* m., quite common in Rhode Island, where Mrs. Bridgham has collected it. After examining Mr. Walker's type of *Stellata*, which is larger and with pink hind wings and an apparent slight modification of the markings of fore wings, I feel sure that it is only a varietal form of *Henrietta*, though this was next to impossible from the description. I have seen no such specimen among hundreds of *Henrietta* which have passed through my hands, and the only approach to it was a ♀ specimen, collected by Mrs. Bridgham, which had a faint pink flush on hind wings. The genus *Euedwardsia* is based on a fine species somewhat stouter and larger than *Xanthothrix Ranunculi*, with hairy vestiture, unarmed tibiæ, the clypeus with a projection below a cup-like excavation. The eyes are naked, the primaries are rather short and broad, with sharp apices. There will be a difference of opinion as to the value of structure in this group. I do not agree with Lederer in referring *Pyrrhia Umbra* and *Charicles Delphinii* to one genus. But there is no need of personal criticism, and no mental inferiority or biological ignorance implied in separating certain species upon

slight structural characters. I am inclined to keep in view the general appearance and pattern of the insects in sorting them into genera, this has led me too far in the present group, as shown by Mr. Smith, and I have modified my views in consequence. There may be a question as to two or three genera which I here retain, but no harm is done by keeping them separate, and the natural grouping of the insects is facilitated. In but few cases have I overlooked the characters as charged by Mr. Smith, I have rather failed to recognize their true importance, and, without the European types before me, and wanting some rare American species, it was difficult to avoid making too many genera, considering the strong modifications in armature exhibited by the different species. After having positively referred *Oxylos* to *Heliothis*, Mr. Smith as positively now refers the genus to *Alaria*. Perhaps, when our species are all known, the genus may turn out to be valid; it differs very slightly from *Heliothis* as stated by me, the shape of the wings divide it from *Alaria*; thus I leave it for the present with one or two others, and having again gone over the generic types accessible to me in this group, the present arrangement expresses my final decision and comprehension of the matter.

22. *Acontiinæ* m. This group contains the large genus *Tarache* (*Acontia* Ochs.) which is numerously represented in Africa and Southern Europe. Our American forms are only partially known. The vestiture is scaly, mossy and short on the front, the eyes are full, large, naked and unlashed. The colors are white with shades of olivaceous or purply, on fine dark streaks and scintillant patches. The finest species is *Tarache Lactipennis* Harvey, which simulates *Ciris Wilsonii*. *Trichotarache* differs in the important character of hairs mixed with the body vestiture; it borrows a character from the preceding group; the moth closely resembles *T. Flavipennis* in appearance. *Trileuca* has the shining look of *Tarache*, and in the body parts resembles my *Buzea* from Texas, which has an European analogue, judging from descriptions. The tibiæ are unarmed; both forms have three pale transverse lines, and are of a peculiar fady ochry color.

23. *Eustrotiinæ* m. This group is equivalent to the *Noctuo-Phalænidi* of Boisduval, and contains mostly weak-bodied and frail-winged forms of which a few are remarkably distinct in structure. *Spragueia* differs from the European *Agrophila*, by the absence of vein 5 on the secondaries, and the narrower fore wings, which have the course of the subcostal veinlets modified. *Thalpochares* has no accessory cell; I have examined the neuration alone of *Ætheria* and *Putula*. *Euherrichia* is of a rich brown color with silver spots and lines, and has been confounded with the European genus *Eriopus*, of which latter genus we have a Floridian representative. *Annaphila* is a curious Californian genus, the species looking like miniature *Catocalæ*; the genus appears to me related to *Eustrotia*. *Azenia* is remarkable for the clypeal structure. *Exyra* has a roughly haired thorax, and the species feed, in the larval state, on the Pitcher Plant (*Sarracenia*). The economies of nature are very curious. While many flowers, in losing their honey, have their seeds ripened by the pollen brought to the ovary

attached to the moth or bee that steals their sweets, in the genus *Saracenia* the leaves are eaten by the larva of *Ezyra*, the moths of which are afterwards caught in the trap which first helped them to exist. The insect first devours the plant, and then the tables are turned, and the plant catches the moth which eat its leaves as a caterpillar. The species of *Ezyra* are all pretty, while *E. Rolandiana* is one of the most beautiful of our smaller *Noctuidæ*, in fact few equal it in depth and richness of coloring. *Prothymia coccineifascia* has beautiful waxy, red stripes on its yellow wings, while for bright and elegant markings and high color few natural objects are as exquisite as *Spragueia Leo* and *S. Magnifica*. The latter species, from Arizona, is even handsomer than the species of the Tineid genus *Æta*, which these little *Noctuidæ* somewhat recall. I have worked out the structure of *Agrophila* (*Erotyla*), *Spragueia* and *Xanthoptera* very fully in the pages of the "Canadian Entomologist," edited by my kind friend, Mr. Wm. Saunders.

24. *Hyblæinæ* m. This group is tropical and is composed of singular-looking Noctuids, having tortriciform primaries, pointed apices, smoothly-haired thorax, with pointed palpi. The narrow wings and closely-haired body give the group a resemblance to the *Acontiinæ*. The hind wings are black and yellow, and in many features the group prepares us for such Catocaline forms as *Hypocala*. We have one species from Florida, *Hyblæa Puera* Fabr., which has been apparently redescribed by Mr. Strecker as a new genus and species under the odd name of "*Ænigma Mirandum*," the genus being based on a "very large number of subcostal nervules," an impossible one where it is considered that the number of these veins is invariable.

FERALIA Grote (1874).

Type: Diphthera Jocosa *Guen.*

The eyes are small, naked, lashed. The head is retracted and the palpi shorter than in *Diphthera fallax*, which latter I regard as belonging to *Diphthera* as Hubner originally intended the genus. The male antennæ are stoutly but shortly bipectinate throughout their length. I could not find ocelli, but Mr. Smith says they are small but present. The vestiture is very shaggy and hairy. The species varies by becoming suffused with black; the fore wings are green, and the female has them pale green with distinct black mesial bands and lunule beneath.

1. F. Jocosa *Guen.* Noct. 1, 47; Grote, B. B. S. N. S. II., 58 ♂, Can. Ent. XV., 28 ♀. Maine; N. York; Canada.

MOMAPHANA Grote.

Type: M. Comstocki *Grote.*

This genus is allied to *Diphthera*, the vestiture being similar, and the moth otherwise in markings and color resembling *D. Fallax*. The male antennæ are distinctly pectinate, however, and in this resembles *Feralia*, from which it differs by the less retracted head. The single species is so

rare that I never have had but one specimen to examine in which the labial palpi were much shorter than in *Diphthera Fallax*. The eyes were fuller than in *Feralia*, and the body less pilose. The ocelli were present. The moth stands evidently between the *Feralia Jocosa* and *Diphthera Fallax*, and the genus must be again studied, though I do not doubt its validity.

1 M. Comstocki *Grote*, B. B. S. N. S. II., 59 (*Feralia*), Stett. Ent. Zeit. New York.

ADITA Grote (1874).

Type: A. Chionanthi *Abbott and Smith.*

The moth is allied to *Agrotis*, from which it differs by the fore tibiæ being provided with a stout claw as in *Oncocnemis*. Middle and hind tibiæ sparsely spinose, while the front tibiæ seem to have only the terminal claw, and to be destitute of spinules. Abdomen untufted. Male antennæ bipectinate, rather long. Head prominent, eyes full, naked. Fore wings retreating at anal angle. The thorax is crested behind. The moth is figured by Abbott in 1797, and remained undiscovered, and even unnoticed again until 1874, when I found it in a collection made by Prof. Comstock at Ithaca, New York. It is a large, distinctly marked and handsome species, expanding about 42 mil., and has since been found in Massachusetts, but is as yet rare in collections.

1. A. Chionanthi *Abb. & Sm.*, II., Pl. 98; Grote, B. B. S. N. S. II., 63. Mass. to Georgia.

HILLIA Grote.

Type: Hadena Senescens *Grote.*

This genus is allied to *Hadena* with which it essentially agrees, but differs by the retracted head and short body, and the straight costal margin of the primaries, the wings being wide and short, rather than comparatively long and narrow. Male antennæ simple, ciliate; eyes naked, lashed. A tuft behind the collar and on thorax behind. Tibiæ unarmed. Abdomen untufted.

1. H. Senescens *Grote*, Can. Ent. 10, 235, New York.
2. H. Vigilans *Grote*, B. U. S. G. S. 4, 176, Maine.
3. H. Algens *Grote*, Can. Ent. 10, 236, Maine.

I name this genus for W. W. Hall, Esq., of Albany, who collected the type, and has been exceedingly kind to me in scientific matters.

COPIVALERIA Grote.

Type: Valeria Grotei *Morr.*

This form has a roughly haired thorax, the head being somewhat sunken, the male antennæ impectinate. The form is like *Hadena*, but it differs by the claw on front tibiæ. The aspect is not unlike the European genus *Valeria*, and it is removed from *Dicopis* by the longer wings and abdomen.

1. C. Grotei *Morrison*. Eastern and Middle States.

HADENELLA Grote (1883).

This genus is based on a Hadenoid of slight build, having triangulate, broad wings, the infra-clypeal plate prominent, a curious projecting frontal horn terminating in a navel-shaped expansion. The thorax is tufted behind, the antennæ simple, the eyes naked; a small basal tuft on the abdomen. The little moth is gray, shaded over apices and the middle of the wing with ochreous, thus resembling in miniature *Agrotis Pluralis*. It is of the same slight form, but brighter colored than the dusty gray *Hadena cylindrica*.

1. H. Pergentilis *Grote*. Arizona.

PSEUDANARTA Hy. Edw. in litt.

Type: P. crocea *Hy. Edw.*

This genus is composed of small Hadenoid forms which have clear yellow secondaries with black borders, and resemble *Anarta myrtilli* in appearance. The eyes are naked, the head not as prominent as in typical Hadenoid species. The antennæ are simple, the vestiture hairy, the thorax tufted. It is a color genus apparently as the tibiæ are unarmed, and beyond the peculiar color, and somewhat compressed form I do not find distinctional characters, although I cannot help believing that such exist. The species are near, but I now believe are all distinct. All but *Aurea* have yellow, this has orange secondaries. The fore wings of *Crocea* are shaded with ochrey and paler than the others. It is probable that the ♀ oviduct is exserted, which would give a slight character.

1. P. Crocea *Hy. Edw.* Colorado.
2. P. Flava *Grote*, Col.; B. Columbia.

TOTA Grote (1882).

Type: T. Armata *Grote*.

Size small, form compact, fore wings somewhat tortriciform, shaped like the European *Senta*, with hadeniform ornamentation, gray, with faint markings finely outlined. Tibiæ slender, unarmed, fore tibiæ with a short claw. Clypeus with an exceedingly prominent wedge-shaped protuberance, surmounting the greatly exserted infra-clypeal plate. Hind wings rather full, rounded, the fringe prominent. Two species, one larger with pale fuscous or smoky secondaries, the second smaller with glistening white hind wings, resemble each other closely in appearance. On examination, the central point of the clypeal wedge has a shallow depression on top in the second smaller form (*minorata*), in which the head and collar are distinctly ochrey. The larger form (*armata*) has a variety having a submedian and discal black streak; this recalls the *var. Bipuncta* of the European species of *Senta*, although it is the stigmata which are filled with black. The untufted body, the clypeal armature resemble *Nonagria;* the small species have the look of internal feeders.

1. F. Arnata *Grote*, Can. Ent. 175. Arizona.
2. F. Minorata Grote, Can. Ent. 181. Arizona.

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UFEUS Grote (1873).

Type: U. Satyricus *Grote.*

A very flat-bodied, coarsely-haired genus with shiny feet and simple antennæ, the middle and hind tibiæ spinose, as also the fore tibiæ in at least two of the species. The body is untufted, and in form the moths resemble *Heliophila*, and are classified by me at the end of the subfamily group. *Nonagriina* m. The naked eyes are lashed. The type is found in Canada, and the Northern States. I suspect it hibernates as a moth. The early stages are unknown.

1. U. Satyricus *Grote*, B. B. S. N. S. I, 101, Pl. 3, fig. 4. Can. to N. Y.
2. U. Unicolor *Grote*, B. U. S. G. S. IV., 179. Illinois.
3. U. Plicatus *Grote*, B. B. S. N. S. I., 102. Can. to California.
4. U. Sagittarius *Grote*, Pap. III., 31. California.

The ornamentation is simple; *Satyricus*, a large species, fuscous, with cloudy medial lines, *unicolor* smoky-fuscous, unlined.

Plicatus is brownish-red with medial lines and varies in tint; it is smaller than *Sagittarius*, which has red primaries with a yellow longitudinal streak on cell joining the bow-shaped yellow reniform, while beneath the secondaries have a thick triangulate mark. This species is the most interestingly marked in the genus. The flat form, coarse hair, strongly spinose and powerful feet are unmoth-like, and when I examined *Satyricus* I was reminded of a cockroach, though I confess it requires a strong imagination to even suggest such a resemblance.

FOTELLA Grote (1882).

Type: F. Notalis *Grote.*

This genus is related to *Caradrina*, and has a slight correspondence to *Acosmetia* in form, the fringes are long on hind wings. Clypeus with a navel-shaped expansion. Eyes unlashed, naked. Ocelli. Wings full; the color and markings recall *Bryophila Teratophora.* Tibiæ unarmed; body slender, untufted; vestiture silky.

1. F. Notalis *Grote*, Can. Ent. 14, 181. Arizona.

ACERRA Grote.

Type: A. Normalis *Grote.*

This genus is, I believe, synonymous with *Perigrapha* Led. It has the characters of *Tæniocampa*, except that the body seems stouter and shorter, and there is a medial ridge on the thorax. Our species seem to differ by the impectinate ♂ antennæ. The European species have large confluent stigmata, and our first two species have them thus, and very prominently colored, the next two have them also coalesced, but not so prominent, and in the last two the stigmata are separate and inconspicuous. The genus seems to sustain a similar relation to *Tæniocampa*, that *Ammoconia* does to *Agrotis* or *Epiglæa* to *Glæa.*

1. P. Normalis *Grote*, B. B. S. N. S. II., 162; Check List, fig. 4. California.
2. P. Muricina *Grote.* B. B. S. N, S. III., 85. Oregon.

3. P. Behrensiana *Grote*, Can. Ent. VII., 71. California.
4. P. Plusiiformis *Hy. Edw.*, Pac. Coast Lep. 4, 3, Pl. 1, fig. 9. Nevada.
5. P. Erythrolita *Grote*, Can. Ent. XI., 208. California.
6. P. Transparens *Grote*, B. U. S. G. S. VI., 582. Washington Terr.

The genus *Stretchia* of Hy. Edwards, with the type *S. Plusiiformis*, is also synonymous. The handsomest and most striking species is *Muricina;* while *Erythrolita* has much the look of a *Tæniocampa*, its larger ally. *Transparens* has a certain false look of *Phragmatobia*, from its subtransparent rufous primaries with their faint ornamentation. The hairy eyes and the dorsal ridge of scales on the thorax must be observed.

CEA Grote (1883).

Allied in form, texture and vestiture to *Trichocosmia*, between this and *Calymnia*. Eyes naked, unlashed. Vestiture of narrow scales. Antennæ simple. Front wide, rising to an embossed protuberance, around which the short clypeal vestiture circles; infra-clypeal plate distinct. Ocelli. Labial palpi slender, rather weak, with elongate third joint. The body has a pale integument, the outline weak, and the vestiture is not strongly adherent. Tibiæ unarmed; legs rather short and weak, not hairy. Body untufted; abdomen with dorsal carina. Wings entire, rather broad and short; apices determinate and outwardly the primaries are full. One species with thorax and primaries very pale yellow, almost white, immaculate. Hind wings pure silky white above and below, abdomen white, expands 27 mil.

1. C. Immacula *Grote*, p. III., 78. Arizona.

CIRRHOPHANUS Gr. (1872).

Type: C. Triangulifer *Gr.*

The eyes are full, naked, unlashed. The clypeus has a central rounded tubercle. The vestiture consists of hair-like scales with broader ones, arranged like shingles, rising from the thorax, which is short and in shape allies the moth to this group. The fore tibiæ are also not truncate, but as long as in the preceding genera and unarmed. The parts of the thorax resemble the preceding genera, but there is a divided posterior tuft. The patagia are not as deflected as in *Plagiomimicus*, but do not lie close to the thorax. The female ovipositor is not exserted. The abdomen is untufted. The labial palpi have the terminal joint concealed, and are not unlike, though longer, the palpi of the genera separated here from *Basilodes*, but unlike that genus. The antennæ have the basal joint scaled. The palpi are rather thickly haired. The tibiæ are unarmed. Wings ample, without tooth, rounded exteriorly, with blunt apices, and running in a little and forming a prominent angle at internal margin. The genus seems to be somewhat intermediate between the preceding and *Plusia*. The species is golden-yellow with orange-brown lines disposed somewhat like the European *Charicles Delphinii*.

1. Triangulifer *Gr.* Ohio, Missouri.

Pretiosa Morr. (Charicles).

CHAMAECLEA Gr. (1883).

Type: C. Pernana *Gr.*

Allied to the genera typical of the *Stiriinæ* by the bulging clypeus and Plusia-shaped wings. Front with a slight depression, rising in the middle. Vestiture scaly. Tibiæ unarmed; in all the examples I have seen the fore legs are broken off. Fore wings wide, produced at internal angle. The tegulæ are not deflected; the thorax short. ♂ antennæ simple.

1. Pernana *Gr.* Arizona. This genus is curious for the way in which *Chamæclea Pernana* mimics *Chariclea Delphinii.* The type is figured in my Illustrated Essay on the Noctuidæ of North America, Plate III. fig. 27.

PLAGIOMIMICUS Gr. (1873).

Type: P. Pityochromus Gr.

Front with an empty and exposed cup-shaped protuberance, the frontal scales being short and mossy. A slender terminal claw on front tibiæ. In *Tepperi* the frontal excavation is less prominent, but otherwise this species agrees. As compared with allied genera, the three species are slenderer and have a casual resemblance to the Heliothid genera *Schinia* and *Lygranthœcia.* As in *Stibadium* the labial palpi are short, here they hardly reach the top of the more prominent infra-clypeal plate in the more typical forms. The species are olivaceous fuscous (*Pityochromus, Expallidus*), or of a delicate olivaceous green (*Tepperi*). Both Mr. Morrison and Mr. Smith wrongly give the fore tibiæ of *Tepperi* as unarmed.

1. Pityochromus *Gr.* Mass to Kansas and the South.
   Schinia media Morr.
2. Expallidus *Gr.* Montana.
3. Tepperi *Morr.* Southern States, Arizona.

HELIOSEA Grote (1875).

Type: H. Pictipennis *Grote.*

A small Heliothid allied to *Heliophana* and *Melicleptria.* It differs by the fore wings being more widened outwardly, and the claw to the front tibiæ being single. Mr. Smith says of it: "Very unsatisfactorily distinguished from *Heliophana* and probably identical with it." I cannot reexamine my type at the moment. When I established the genus, I was under the impression that the modifications of the armature of fore tibiæ gave generic characters. With the discovery of numerous Heliothid forms this opinion has become modified.

1. Heliosea Pictipennis *Grote,* Ill. Essay, p. Plate 3, fig. . California.

MELICLEPTRIA Hubn. (1816).

Type: M. Cardui *Hubn.*

This genus, which I took from Hubner, is equivalent to Lederer's first section of *Heliothis* as shown by me, and, with the same type, the equivalent of Guenée's genus *Anthœcia.* I followed Guenée in including in it

such forms as *Saguarina*, etc., but in my "New Check List" limited it more rigorously to the purple and black forms. *Celeris*, a magnificent species, is, as I twice showed from examination of specimens, a true *Melicleptria*, it was misplaced accidentally in my list. Mr. Smith has farther taken out a few species described under it by Mr. Hy. Edwards and Mr. Morrison, which with similar ornamentation are shown to differ structurally. I cannot now examine all these while he is apparently justified in his course. I cannot believe he has correctly placed *Perminuta*, but I only saw the type, and have never had the species under the microscope. He follows Mr. Edwards in regarding my genus *Adonisea* as synonymous. I suspected as much myself, but the species was too handsome to leave undistinguished, and it has a slightly different proportion from the rest. This insect, which I call "Adonis' Moth," is purply red and blue, the latter shade a very unusual one in the ornamentation of these insects. I described the genus with other Californian genera, but my present knowledge of related forms would have deterred me from doing so. The species of *Melicleptria* have naked, small or ornate eyes, which are sunken in the hairy vestiture of the retracted head. The middle and hind tibiæ are spinose. The fore tibiæ in *Pulchripennis* have a longer inner and two outer claws, and as in most of the genera the joint is short. Mr. Smith says "the body is clothed with thin divergent hair, usually of a paler color than body [?] and somewhat silky." He thus describes the sericeous somewhat olivaceous or yellowish longer vestiture on thorax and abdomen which is distinctive and with the purply red wings, with paler median spots on both pair, is characteristic of most of the species. Mr. Smith further gives the "claws of tarsi simple or but slightly dentate." In the female the ovipositor is extended beyond the conical and rather short untufted abdomen. A typical species is *M. Sueta*, with its Californian variety *Californiensis*.

1. M. Celeris *Grote*, B. B. S. N. S. I., 148. California.
2. M. Pulchripennis *Grote*, Ill. Essay, 62, Pl. III. fig. 31, *var.* Languida *Hy. Edw.* California.
3. M. Villosa *Grote*, P. E. S. P., 531, Pl. VI., fig. 6. Colorado.
4. M. Persimilis *Grote*, B. B. S. N. S. I., 117, Pl. III. 11. Colorado.
5. M. Græfiana *Tepper*, Tr. Am. E. S. 245. California.
6. M. Honesta *Grote*, Papilio I., 77. California.
7. M. Sueta *Grote*, B. B. S. N. S. I., 117. Colorado.
   var Californiensis *Grote*. California.

LYGRANTHŒCIA G. and R.

Type: Anth. Rivulosa *Guen.*

The type of this genus was first described as *Crambus Marginatus* by Haworth. It is a sufficient answer to Mr. Smith's prejudiced procedure of calling this genus *Schinia*, and giving himself the air of first discovering it, to quote my words from my paper in the Buffalo Bulletin II., 220, which is the only one I had published on the subfamily *Heliothinæ*. "The

eyes are full. The fore wings of the usual shape, crossed by two or more less evident lines. The fore tibiæ have a series of three outer claws or spinose, a single inner longer terminal claw, succeeded by a row of slender spines. The species are numerous, and I refer them all to *Lygranthæcia* G. and R. They are *bina, lynx, brevis, atrites, arcifera, Spraguei, Puckardi, Mortua, jaguarina Marginata, Thoureani, saturata.*" It will thus be seen that I referred all the then known species to this genus. I only left out my *Tricopis* and *Euleucyptera*, which to-day I am not willing to add, as also Hubner's *Schinia* then not known to me, or but partly. I afterwards in my "New Check List," proposed to divide the species into two genera, but incorrectly. I also described some new species (incorrectly, as Mr. Smith has shown) under *Tamila*. But the first attempt to limit this large genus scientifically is that above given, and to now call that genus *Schinia*, a term "resurrected" by myself out of Hubner for two or three of his species, is quite unjust and against the usual comity and practice, and I hope will not be followed by any one. The species I now arrange as follows: I have adopted Mr. Smith's conclusions except as above noted, but the genus is virtually my genus *Lygranthæcia*, and its value is not altered by referring to it a few species hitherto wrongly placed by me. I had not the type of *Tamila*, and was misled by Guenée's diagnosis, and my own prepossession that the flattened thoracic scales distinguished *Tamila*, while in reality all the species have them. The genus is well distinguished by the full, not ovate or narrowed eyes from its allies, and thus stands near the typical *Heliothis armiger*.

RHODODIPSA Grote (1879).

Type: R. Volupia *Fitch*.

This genus is nearest to *Lygranthæcia*, and differs in detail of armature from *Rhodophora* and *Alaria*. The second species from New Mexico may not belong here, the front tibiæ of the type were imperfect. Both have light crimson secondaries and honey-yellow thorax. The fore wings of *Volupia* are also red with fine pulverulent pale lines, while those of *Miniana* are clay-color with broader white lines, recalling those of *L. Velaris*. Mr. Smith unites the first species with *Alaria*, and having been so fortunate as to see Dr. Fitch's type, confirms my identification in my Illustrated Essay, p. 63, and elsewhere; alone from the description certainty as to the species intended by Dr. Fitch could not be attained.

1. R. Volupia *Fitch;* Gr. B. U. S. G. S. III., 797; Ill, Ess. 63, Pl. 3, 33. Texas; Colorado.

2. R. Miniana *Grote*, Papilio I., 175; II, Pl. I., fig. 1–2. New Mexico.

PORRIMA Grote (1875).

Type: Oria Sanguinea *Geyer*.

This is a catalogue name proposed by me instead of Guenée's generic term *Oria*, preoccupied by Hubner. I found afterwards that the near-

est ally of this moth was the *Heliothis Regia* of Mr. Strecker, a moth which I had previously referred to *Lygranthœcia* (= *Schinia* Smith) before Mr. Smith wrote on the subject. In his "Synopsis," Mr. Smith says: "Congeneric with this (*Alaria*) are *Porrima* Gr., and *Rhodophora* Guen. The former seems to differ in being rather more coarsely haired, more wooly (woolly) beneath, having the primaries a little wider, and the fringes longer. The latter has the vestiture a little finer, and the palpi slightly drooping instead of horizontal; there is also a very slight difference in the armature of the anterior tibiæ; *but compared carefully with each other the conclusion that they are identical is irresistible;* not only do they agree in outine and general characteristics but even the coloration, slight as it is, would seem to bring them together" (l. c. p. 19). The italics are mine. In his next paper Mr. Smith refers *Sanguinea* to *Schinia!* I believe Mr. Smith is right in his last conclusion, and I have referred *Sanguinea*, next to *Regia*, to *Lygranthœcia*. If this opinion should be reversed by later discoveries *Porrima* may come into use for the genus as intended by Guenée. I have quoted Mr. Smith to show how easy it is to be positive and change one's opinion quite quickly. A very long continued study and a knowledge of the greater part of our *Noctuidæ* has shown me that it is better to be not so positive as matters are at present. I differ decidedly from Mr. Smith's opinion that *Sanguinea* is like *Florida*. The genus *Porrima* must for the present be regarded as not sufficiently distinct from *Lygranthœcia*. I do not in the least object to a change in opinion upon such matters, but I object to being adversely criticised for changing my opinions by one who changes his own. The process in itself is a very natural one, without which all progress would be impossible. A scientific man is one who changes his views with facility upon the discovery of fresh evidence, and one also who is quick to see the bearing of fresh evidence upon the subject in hand.

OXYCNEMIS Grote (1882).

Type: O. Advena *Grote*.

A Heliothid genus with shortened fore tibiæ which are corneous and terminate in a single claw. Vestiture scaly. Thorax with posterior tuft of curved scintillant scales, widening towards their tips. Eyes naked, unlashed. Abdomen short, untufted. The moth is gray, brightly marked, with distinct hadeniform ornamentation, of small size and from its essential features I place the moth next to *Triocnemis*. The type is in Mr. Neumoegen's extensive collection.

1. O. Advena *Grote*, Can. Ent. 14, 182. Arizona.

AZENIA Grote (1882).

Type: A. Implora *Grote*.

Size small, allied to *Prothymia*. The vestiture is flattened hairy. Eyes naked, unlashed. Antennæ simple. Legs unarmed and tibiæ thinly scaled. Front with infra-clypeal plate prominent, overshadowed by a parallel,

long, distinctly tridentate, flattened clypeal protuberance. Labial palpi oblique, rather stout and longer than in *Xanthoptera*. The type is pale lemon yellow with dots in place of median lines and pale fringes. The second species is dark yellow without marks and uncolorous fringes; the frontal armature has its outer edge roundly scalloped instead of forming the three sharp teeth of *A. Implora*.

1. A. Implora *Grote*, Papilio II., 186. Arizona.
2. A. Edentata *Grote*, Can. Ent. XV., 25. Arizona.

EUHERRICHIA Grote (1882).

Type: Eriopus Monetifera *Guen.*

Form slender; abdomen not exceeding the secondaries, tufted at base, and especially on third segment. Eyes naked, unlashed. Ocelli. Tibiæ unarmed. Vestiture consisting of flattened scales mixed with hair. Wings broad, entire, apices determinate, outer margin retiring below apex, full at median nervules; a distinct accessory cell; 9 out of 8 to apices, about half the length of 8; cell open; 3 twice further from 4 than 4 from 5 at base. Hind wings with vein 5 a little weaker, indistinctly connected with median series. The species are rich reddish-brown ornamented with silver spots and lines recalling *Plusia* and having somewhat the soft rich color of *Plusia Mappa*. The species have been mistaken for forms of *Eriopis*.

1. E. Monetifera *Guen.* Can. to Florida.
2. E. Mollissima *Guen.* Can. to Florida.
3. E. Floridensis *Guen* Florida.

I conclude this paper by briefly referring to the fact that I have determined my species in many collections. I enumerate those of Mr. Thaxter, Mr. Neumoegen, Mr. Hy. Edwards, Mr. Tepper and in the Albany collections. A large number of my types are in Mr. Neumoegen's grand collection, and I have figured a good number of the species. There can thus be but few cases of doubt as to what I have described. I had intended, in memory of many kindnesses, to dedicate a second illustrated work to Mr. Roland Thaxter, but circumstances prevent me, and if he will accept the present paper on his favorite subject, I shall be glad. I know of no one who by natural temper and talent is better fitted to continue the description of North American *Noctuidæ* than Mr. Thaxter, could he be induced to undertake the work.

A Revision of the Lysiopetalidæ, a family of Chilognath Myriopoda, with a notice of the genus Cambala. By A. S. Packard, Jr.

(Read before the American Philosophical Society, June 16, 1883.)

In the course of some studies on the cave-fauna of the United States, it became necessary in treating of the cave-inhabiting myriopods to work carefully over their structure, and as they all, with a single exception, belong to the *Lysiopetalidæ*, a revision of a group which has been hitherto much neglected, may prove of service to zoölogists.

My material mainly consists of specimens collected by myself for the Kentucky Geological Survey; also, some collected by Mr. F. G. Sanborn for the same survey. I have also been indebted to Mr. E. Burgess, Prof. C. V. Riley and U. S. Department of Agriculture, for a few specimens.

Until 1840, when Brandt described the genus Lysiopetalum (and its synonym Spirostrephon), no genus of the family, as it is now understood, existed. In his Recueil, p. 42, he referred some southern European species to his new genus Lysiopetalum, mentioning *Julus fœtidissimus* Savi as the type. On p. 90 of the same work he proposed the genus *Spirostrephon* for our more common American species, the *Julus lactarius* described by Thomas Say in 1821.

In 1845, in his classical memoir in the Philosophical Transactions of London, on the Myriopoda, Mr. G. Newport proposed the sub-family (with Platops and Cambala as generic types) *Lysiopetalinæ*, with the following brief diagnosis: *Pedes laminis mobilibus affixi.*

In 1865, in his Myriopoda of North America, published in the Transactions of this Society, Dr. H. C. Wood, Jr., recognized the family rank of the group for which he proposed the name, *Lysiopetalidæ*, with the following diagnosis: "Sterna atrophied, not coalescent with or united by suture to the scuta." The type and only genus mentioned is *Spirostrephon* (*S. lactarius*).

Mr. Ryder's paper in the Proceedings of the U. S. National Museum, 1880, was the first attempt to enumerate the species, and his detection and account of the genus Zygonopus added materially to our knowledge of the group.

The synonomy of the family will be as follows:

Family Lysiopetalidæ Wood.

Lysiopetalinæ Newport, Phil. Trans.. xix, 278, 1845.

Lysiopetalidæ Wood, Trans. Amer. Phil. Soc., xiii, 137, 1865.
Koch, Verh. Zool.-bot. Ges. in Wien, xvii, 1867 (Zool. Record, p. 194, 1868).
Ryder, Proc. U. S. Nat. Museum, iii, 524, 1881.
Packard, Amer. Nat., xvii, 328, March, 1883.

PROC. AMER. PHILOS. SOC. XXI. 114. W. PRINTED SEPTEMBER 15, 1883.

Synopsis of the Genera.

A. Body not setose; antennæ long; male legs of eighth pair not modified; genital armature of normal proportions.....*Lysiopetalum* Brandt.
Male legs of eighth pair modified, six jointed; genital armature small *Pseudotremia* Cope.

B. Body setose.
Body short and thick, eyes triangular; antennæ slender; setæ one-fifth as long as body is thick; legs short.....*Cryptotrichus* Packard.
Body short and fusiform, eighth pair of legs of male two-jointed; setæ half as long as body is thick .....*Trichopetalum* Harger.
Body slender; eighth pair of male legs two-jointed, ending in a claw; setæ very long; eyeless.....*Scoterpes* Cope.
Like Scoterpes; setæ a little shorter; sixth pair of male legs greatly swollen .....*Zygonopus* Ryder.

Characters of the Family. The diagnostic characters of the group, as distinguished from the Julidæ, are as follows: Head broad, wider than the body in front; genæ much swollen, front flat; eyes situated in a triangle, often partly or wholly aborted; antennæ seven-jointed, much longer and more setose than in the Julidæ, especially the third and fifth joints, and also the seventh (terminal) joint. Body subfusiform, constricted behind the head, the first and second segments being much narrower than in the Julidæ. The segments usually divided into an anterior raised portion, often with longitudinal ridges, and a posterior plain depressed smaller portion; on the sides of the anterior portion of the segments of the anterior half or two-thirds of the body a swollen boss or hump, with three setiferous tubercles; the setæ from one-third to two-thirds as long as the body is thick. Feet very long and slender, as long as the body is thick, or sometimes longer. The coxæ contiguous, the sterna very rudimentary, not united with the scuta. In the males the sixth pair of feet enlarged and swollen (in Zygonopus); the eighth pair two-jointed and rudimentary; number of body-segments variable; end of body pointed.

To enter into more detail, the following comparative description of the family characters may be useful:

The Head. The head of the Lysiopetalidæ is more like that of the Polydesmidæ than the Julidæ; the genæ are remarkably swollen, and as in the Polydesmidæ separated by suture from the rest of the epicranium; they are higher and narrower oval than in the Polydesmidæ. The front of the head is much flattened, forming a squarish pseudo-clypeal region separated by a faint suture from the epicranium; the sides of the head or genal region are swollen, forming a slight median depression on the vertex. The labrum is much as in the Julidæ, with three median nearly equal teeth, and with four setæ on each side as in the Julidæ. Finally, in the form and anatomy of the head, the Lysiopetalidæ approach the Polydesmidæ more closely than the Julidæ; the nearest approach to the family in

the Polydesmidæ is seen in the head of *Polydesmus ocellatus* Pack. and *P. cavicola* Pack., both American forms.

The Eyes. When well developed the eyes are equilaterally triangular, *i. e.*, the ocelli are arranged in a triangular area; in *Lysiopetalum lactarium* there are 40–41 facets arranged in rows. In *Cryptotrichus cæsioannulatus*, where the eye is also developed, there are about 24 facets; as several of the species inhabit caves, and suffer a partial or total loss of eyes, there is much variation in the number of ocelli; in *Pseudotremia cavernarum* the eyes are irregularly linear; the ocelli being arranged in about four irregular groups, with 11–19 ocelli, the number of ocelli varying in different individuals of the same species. In Trichopetalum the ocelli vary from 10–19. In *Scoterpes* and *Zygonopus* the eyes are entirely wanting. In those eyes which are partially aborted, there are a few partly developed ocelli, less than half as wide as, and scattered irregularly among, the normal ones.

The Antennæ. These are much longer and slenderer than in any Julidæ, and more nearly resemble those of the Polydesmidæ than the former family; but differ from both groups in the much longer terminal joint, and in the decided inequality in the relative length of the joints, the third and fourth joint being much longer than the others; the number of joints in our American species being invariably seven (not counting the basal undeveloped eminence to which the first joint is attached). The antennæ are longest and slenderest in Pseudotremia and Lysiopetalum, and shortest in Scoterpes, Zygonopus and Trichopetalum. The joints are more setose in Trichopetalum, and least so, perhaps, in Scoterpes. In all the genera there are from two to four flattened, enlarged, broad, fusiform tactile hairs situated on the end of the terminal joint. As observed in Lysiopetalum and Pseudotremia, these hairs are two-jointed, the basal joint short and broad; they are filled with granules like the material filling the spaces in the nervous fibres between the nerve-cells in the terminal antennal joint, which is nearly filled with nerve fibres and very small nerve-cells, showing that the antennæ must be very sensitive tactile organs, especially in the blind forms.

The Arthromeres. The body-segments of the Lysiopetalidæ have a definite family form and style of ornamentation. In Lysiopetalum and Pseudotremia all the scutes are ornamented with numerous longitudinal ridges, which end in a point overhanging the depressed, flattened portion of the scute; in Pseudotremia, which is a modification by cave-life of the first named genus, the ridges are more or less obsolete and replaced by flattened, coarse granulations, and the lateral swellings of the scutes are well developed.

In all the other genera, the scutes are not thus ridged, and the lateral bosses or swellings are distinct; in all except Cryptotrichus, the bosses have three setiferous, acute tubercles arranged in an irregular triangle; in Cryptotrichus the tubercles are farther apart, arranged almost in a straight

line, but one situated on the boss, which is smaller than usual; the uppermost tubercle is very near the median line of the body. The setæ are straight and stiff, pointing upward and either forward or backward, and are longest in Scoterpes, and shortest in Cryptotrichus where they are minute and about one-fourth as long as the body is thick. Below and behind the lateral boss, the surface is sometimes chased with nearly parallel oblique lines, or, as in Cryptotrichus, the depressed hinder edge of the scutes is finely striated longitudinally. The end of the body is usually much more acutely pointed than in the Julidæ.

Having received, through the kindness of Dr. Latzel, specimens of *Lysiopetalum carinatum* Brandt, from Dalmatia, which is a very large species, I have been able to examine the repugnatorial pores, which are very distinct, their crateriform openings being situated each between two ridges on the anterior edge of the raised portion of the scute. In *L. illyricum* Latzel, from Austria, they are with difficulty perceived, the area in which they are situated not being discolored with yellow; but they can be detected with a half-inch objective. The two European species mentioned are provided with setæ, while our *L. lactarium* is naked. In the latter species the repugnatorial pores are situated in the middle of the yellow lateral spot, between two carinæ, which are higher and closer together than any of the others. They can be seen with a Tolles triplet.

Examining the cave Lysiopetalid, *Pseudotremia cavernarum* Cope, from Wyandotte cave, and a variety, *carterensis*, which inhabits the Carter caves, Ky., I cannot with certainty discover their site, as they are nearly, if not quite, obsolete. It is possible that in cave species, where there are apparently no enemies of these myriopods, their pores become at least externally obsolete.

The Legs. The number of joints of the legs in general is six; the second and third, especially the third, being the longest (this inequality in the length of the joints is an important family character); the fourth and fifth joints are very short, about equal in length, while the sixth and last joint is long and slender, ending in a slender claw.

Of the three pairs of primary or larval legs, the first pair are variously modified in different genera. In *Lysiopetalum lactarius* the first legs are rather flat and short; the third joint from the claw nearly thrice as long as the second, while the terminal joint is broad, with a series of close-set, stiff setæ of nearly equal length, but increasing gradually in length distally; the joint is evidently a comb-like structure adapted for cleaning the body, perhaps the mouth-parts. The first pair of legs in Pseudotremia are much longer and slenderer than in Lysiopetalum, six-jointed, and the terminal joint is less comb-like, both edges being densely setose, the inner edge, however, having the stoutest, most regular setæ.

The sixth pair of legs in *Zygonopus* are modified for clasping purposes, the fourth and fifth joints being much swollen, as described in the descrip-

tion of the genus; in all the other genera, as in all Diplopod myriopods, so far as we are aware, the sixth pair of legs are like the others.

In each genus of Lysiopetalidæ, except Lysiopetalum itself, the eighth pair of legs, *i. e.*, the pair situated on the sixth segment or that bearing the male genital armature, is much modified. In *Lysiopetalum lactarium* the seventh and eighth pair of feet, *i. e.*, those before and behind the male genital armature, are as well developed as the other legs; it is probable that owing to the large and long genital armature, reaching beyond the basal joints of the legs, that the latter needs no change in form to assist in clasping the female. In Pseudotremia, however, the eighth pair of legs are much modified, though still six-jointed; the two basal joints are much swollen, of very irregular shape, the coxæ being consolidated; the rest of the leg is much smaller, slender, four-jointed, the third joint of the leg or basal joint of the free portion being as long as the three terminal joints less the long claw. In the three lower genera, Trichopetalum, Scoterpes and Zygonopus, the eighth pair of legs are on the same type; the two latter genera being evidently derived from the out-of-door form, Trichopetalum. In these three genera the eighth pair of legs are much aborted, two-jointed; the outer joint about thrice as long as the basal, and either unarmed or ending in a claw.

*The Male Genital Armature.** This apparatus has only been incidentally studied. In *Lysiopetalum lactarium* and Pseudotremia the *lamina externa* and *lamina interna* are much as in other Chilognaths. In the first-named genus the armature is about as large as in the Julidæ; in the Pseudotremia it is minute. In Pseudotremia and in Scoterpes and Zygonopus there is developed either upon (Pseudotremia) or at the base of the outer lamina a minute spinous appendage which we have not noticed in the figures of Vosges, Wood or Humbert. In each genus observed by us the armature presents characteristic features, so that they appear to have generic but no family characters. In Scoterpes, Trichopetalum and Zygonopus the armature is minute and rudimentary. In Scoterpes its outer lamina is tridentate at the enlarged end, while the inner lamina is sac-like and simple.

Lysiopetalum Brandt.

Julus Say, Journ. Acad. Nat. Sc., Phil., ii, part i, 104, 1821.
Lysiopetalum Brandt, Recueil, 42, 1840.
Spirostrephon Brandt, Bull. Sci. Acad., 1841. St. Pet., 1840. Recuil, p. 90, 1840.
Platops Newport, Ann. & Mag. Nat. Hist. xiii, 266, 1844.
Lysiopetalum Gervais (in part), Aptères, iv, 133, 1847.

* The genital armature of Julidæ have been described and figured by E. Voges in Zeitschrift für wissenschaftliche Zoologie, xxxi, 150. 1878. He regards the seventh segment as the "Copulationsring" of the male, and says, "at the bottom of the deep sac-like membranous connection of the sixth and seventh body-rings lies the Copulations-Organ" of the female.

Cambala Gervais, Aptères, iv, 134, 1847. Exped. à l'Amer. du Sud (Castelneau), Myriop., 17.

Reasia Sager, Proc. Acad. Nat. Sc., Phil., 109, 1856.

Spirostrephon Wood, Myriop. N. Amer., Trans. Amer. Phil. Soc., 192, 1865.
Cope, Proc. Amer. Phil. Soc., 179, 1769.
Ryder, Proc. U. S. Nat. Mus., iii, 526, 1881.

Not *Cambala* Gray, Griffiths, Cuvier, An. King. Ins., pl. 135, fig. 2, 1832.

" *Reasia* Gray.

" *Reasia* Jones, Todd's Cyc. Anat. Art. Myriop, 546.

Body-segments numbering as many as upwards of 60, with as many as 115 pairs of legs; the body unusually long and slender, tapering gradually towards the subacute tip. Head with the front flat, high and narrow, more so than usual; the eyes in a rectangular triangle, composed of as many as 40–41 facets, and not depressed. Antennæ rather long, the joints subclavate, joint 6 not much longer than 4; joints 3 and 5 of the same length; joint 6 rather thick at the end; joint 7 short, thick and conical, much more so than usual.

Body-segments swollen and full, becoming suddenly depressed on the front edge; the swollen portion with numerous raised lines or ridges, with deep concave valleys between; the ridges projecting behind in an acute point. The segment next to the head rather narrower than the head, with the posterior two-thirds ridged; the sides of the segments are somewhat swollen high up on the sides, but not so conspicuously as in Pseudotremia. Legs rather stout, and larger than in Pseudotremia; the first pair rather short and broad, with a regular comb of stiff setæ on the inner edge of the terminal joint. The seventh and ninth pairs of legs, *i. e.*, the pair immediately preceding and following the genital armor, are like the others, not being in any way modified as in Pseudotremia, etc. The genital armature is large and better developed than in any other genus of the family; the outer lamina large, stout, spatulate-mucronate at the tip; inner lamina much shorter than the outer, and with two long acute forks; repugnatorial pores difficult to find.

The genus may be recognized by the long, slender body, tapering to a point, and by the very short conical seventh antennal joint; by the ribbed swollen segments, which are very numerous; by the seventh and ninth pairs of legs being normal, like the others, and by the short, broad first pair, with the regular comb of setæ on the terminal joint.

The genus as here defined will apply to the two Southern European species *Lysiopetalum carinatum* Brandt and *L. illyricum* Latzel, except that they are setose, while our species is not. I am indebted to Dr. Latzel for specimens for comparison.

In proposing the genus Spirostrephon, Brandt (Bull. Sc. Acad. St. Pet., 1840), regarded Say's *Julus lactarius* as the type species, and adding that the eyes are in a triangular area, he indicates its generic difference from *Cambala annulatus*, with which it has been so often confounded.

Although I had originally retained Brandt's name Spirostrephon for our

species, yet upon receiving from Dr. Latzel authentic types of European Lysiopetalum, it is plain that our *S. lactarius* is congeneric with them. The name Spirostrephon should, then, be considered as a synonym of Lysiopetalum. It is difficult to see why Brandt should have separated *lactarius* from his *L. carinatum*.

In his Recueil, p. 42, Brandt thus characterizes his genus Lysiopetalum: *Laminæ pediferæ omnes liberæ, mobiles, cutis ope cum parte abdominali corporis cingulorum conjunctæ. Frons ante antennas dilatata et deplanata in maribus in simul depressa.* The two species mentioned under the generic diagnosis are *Lysiopetalum fœtidissimum* (Savi) and *L. carinatum* Brandt.

Again, on p. 90, "Subgenus seu genus II. *Spirostrephon* Nob." is thus characterized, and he apparently regards it as a subgenus of Julus: Gnathochilarii pars media fossa haud instructa, sede jus loco aream tetragonam planam, plica seu linea derata duplici, superiore breviore et inferiore longiore, supra et infra terminatam, sed sutura longitudinali haud divisam offerens. Spec. 27. Julus (Spirostrephon) lactarius Nob.....Differt habitu a Julis genuinis et Julo (Lysiopetalo) fœtidissimo et plicato affinis apparet. Annuli corporis, quorum posteriores brevissimi, incluso anali 53. Pedum paria 95. Longitudo 10–11^{111}; latitudo summa $\frac{3}{4}^{111}$. Oculi triangulares—Julum lactarium protypo generis Cambala Grayi habuissem, quum figura ab hocce zoologo sub nomine Cambalæ lactarii data (Griffith Anim. Kingd. Insect., pl. 135, fig. 2). The generic characters are not very applicable in distinguishing the genus, the mention of the type alone rendering it possible to understand what the genus is.

The synonymy will be farther discussed under Cambala. In 1844, Newport, having been misled by the specimen of *Cambala annulata* alleged to have been sent by Say as the type of his *Julus lactarius*, places the latter in his genus Platops, which he proposes, with a doubt, thus: "Genus *Platops? mihi.*" The generic characters apply well to the present species, *S. lactarius*.

Dr. Wood, in his Myriopoda of North America, does not attempt, for want of material, to define the genus. Prof. Cope characterizes this and the next genus thus:

Annuli without pores.....*Spirostrephon.*
Annuli with two pores on each side the median line.....*Pseudotremia.*

As we have seen, there are pores in Lysiopetalum, while the "two pores" of Pseudotremia are two of the three setiferous tubercles on the side of each segment.

The genus appears thus far to be represented in North America by but a single species, which ranges from Massachusetts west to Iowa and south to Florida and Louisiana, while in southeastern Europe Lysiopetalum is rich in species.

Lysiopetalum lactarium Say.

Julus lactarius Say, Journ. Acad. Nat. Sc. Phil., ii, part i, 104, 1821.
Spirostrephon lactarius Brandt, Bull. Sc. St. Pet., 1840; Recueil, 90, 1840.

Platops lineata Newport, Ann. Mag. Nat. Hist., xiii, 267, April 1844.
Lysiopetalum lineatum Gervais, Aptères, iv, 133, 1847.
Cambala lactarius Gervais (in part), Aptères, iv, 134, 1847.
Reasia spinosa Sager, Proc. Acad. Nat. Sc. Phil., 109, 1856.
Cambala lactaria Gervais, Exped. l'Amer. du Sud (Castelneau), Myriop. 17.
"*Reana chinosa* Saeger," Gervais, Exped. l'Amer. du Sud. (Castelneau) Myriop. 14.
Spirostrephon lactarius Wood, Myriop. N. Amer., Trans. Amer Phil. Soc., Phil., pl. ii, figs. 11, 11*a*, 192, 1865.
Cope, Proc. Amer. Phil. Soc., Phil., xi, No. 82, 179. 1869. Trans. Amer. Ent. Soc., iii, 66, May, 1870.
Ryder, Proc. U. S. Nat. Mus., iii, 526, Feb. 16, 1881.
Lysiopetalum lactarium Packard, Amer. Nat., xvii, 555, May, 1883.
Not *Cambala lactaria* Gray, Griff., Cuvier An. King. Ins., pl. 135, fig. 2, 1832.
Newport, Ann. Mag. Nat. Hist., xiii, 266, April, 1844.

Two ♂, two ♀. Body-segments exclusive of the head, 61, with 115 pairs of legs. Body and head horn-color, usually mottled and banded with dark blackish horn-color. The head usually with a broad, interantennal, black, conspicuous band enclosing and connecting the eyes. Eyes (compound) of 40–41 facets. Antennæ dull, blackish brown; tip of the terminal joint pale, as also the other joints at their articulation. The body with a median dull yellowish dorsal stripe, and with a lateral row of concolorous diffuse spots, one on each longest lateral ridge (the spots vary much, sometimes covering four or five ridges and extending low down on the sides of the scute. Each scute has, except those near the head and at the end of the body, about twenty-five prominent ridges, the dorsal twelve larger than those on the sides; these ridges are high, with concave valleys between them; the end of the ridges are acutely conical and project over the ends of the scutes.

Length of the entire body 35^{mm}; thickness 2^{mm}.

The above description was drawn up from the Louisiana specimens which were highly colored, banded and spotted. In the Massachusetts specimen the color is uniformly light brown, without the yellowish dorsal line and the lateral spots. The antennæ are much darker, while the legs are paler than the body. The head is much paler than the body; it is dusky on the vertex between the eyes; but there is no definite interantennal band as in the Louisiana examples.

The Iowa specimens resemble in coloration those from Louisiana, but the yellowish dorsal band and lateral spots are not quite so distinct, though the interantennal blackish band is distinct.

Massachussetts and McGregor, Iowa. Mus. Agricultural Department,

Washington, D. C. (Prof. C. V. Riley); Pilatka, Fla., and Milliken's Bend, La. (E. Burgess); "Eastern United States" (Wood); Found under bark in the mountain regions of Tennessee and North Carolina (Cope); St. Louis (Theo. Pergande).

Although this species is evidently the parent form of the cave-inhabiting *Pseudotremia cavernarum*, it has not yet been observed near the Indiana and Kentucky caves, though undoubtedly yet to be found in their vicinity, as it is a wide-spread species. It probably ranges through Central into South America, as Dr. Wood remarks: "I have seen a single specimen, a female, labeled as coming from New Grenada, which apparently belongs to this species." This specimen I have seen in the Museum of the Philadelphia Academy of Natural Sciences, but did not compare it closely with our species; it is much larger than individuals from the United States.

PSEUDOTREMIA Cope.

Pseudotremia Cope, Proc. Amer. Phil. Soc., xi. No. 82, 179, 1869. Trans. Amer. Ent. Soc., iii, 67, May, 1870.
Spirostrephon Cope, Amer. Naturalist, vi, 414. July, 1872.
Pseudotremia Harger, Amer. Journ. Sc. & Arts, iv, August, 1872.
Ryder, Proc. U. S. Nat. Mus., iii, 524, Feb. 16, 1881.

Body consisting of thirty segments; rather long and slender, with as many as fifty pairs of legs. Head with the muscular area (gena) behind the eye very full and swollen, globose, swelling out far beyond the side of the succeeding scutum; front a little longer than wide. Eyes present, black, the outline of the eye-patch narrow triangular, composed of about twelve to fifteen facets, arranged in four or five transverse oblique series. Antennæ longer and slenderer than in any of the other genera of the family; joint 3 is twice as long but not as thick as joint 2, but equals 5 in length, the latter, however, being very slender and clavate; the terminal seventh joint is unusually long, pear-shaped and elongated towards the tip.

The body constricts in a neck-like fashion behind the head; segments (scuta) 5–20 especially have a lateral shoulder or raised portion characteristic of the genus Lysiopetalum; this swollen portion has on each side about six longitudinal ridges, with deep valleys between; above, especially on the posterior half of the body, the dorsal portion of the laterally swollen scuta is coarsely tuberculated, instead of ridged, and the rounded tubercles are rather flat and unequal in size. There are no setæ or lateral setiferous tubercles. The end of the body is as usual in the family, the last segment with three pairs of small setæ arranged one above the other.

Above the middle of the side of the posterior scuta, especially the last six, is a tubercle like those in Scoterpes and Zygonopus, but much smaller, from which a minute hair arises, and above on the upper part of the shoulder there are two rudimentary, very small tubercles.

The legs are long and slender, about one-third longer than the diameter of the body. In the male the eighth pair of legs are much less modified

than in the succeeding genera; it consists of five joints, while in Trichopetalum, Scoterpes and Zygonopus it is very rudimentary, consisting of but two joints. The basal joint is large and constricted near the middle, with a large setiferous tubercle on the inside; the constriction may represent an obsolete articulation, and thus the basal joint really represent the two basal joints of the other legs. The smaller multiarticulate extremity of the leg is composed of four well marked joints, the basal as long as the three terminal ones without the claw, which is long and slender, and nearly as well developed as in the other legs.

The male genital armature is well developed, nearly as much so as in the *Julidæ*. There is a median very long curved forked chitinous rod, a pair of median boot-shaped pieces, and a pair of lateral double blades or pseudorhabdites, composed of the usual *lamina externa* and *lamina interna*, which are variously spined and denticulated at their extremities, one supplementary spine being minutely and densely spinulated.

The genus was characterized by Cope thus: "Annuli with two pores on each side the median line;" as already remarked, the so-called pores appear to be simply the lateral tubercles giving rise posteriorly to minute setæ, which are difficult to detect with a half-inch objective.

The genus differs from Lysiopetalum in the slenderer, longer antennæ, the rudimentary eyes, the more swollen and prominent lateral bosses or shoulders of the segments, while the body has about half as many segments as in Lypsiopetalum, and is much shorter and more fusiform. The generic characters are very marked, though the species is clearly enough derived from the common out-of-door *Lysiopetalum lactarium*.

Pseudotremia cavernarum Cope.

Pseudotremia cavernarum Cope, Proc. Amer. Phil. Soc., xi, No. 82, 179, 1869.
Trans. Amer. Ent. Soc., iii, 67, May, 1870.
Packard, Amer. Naturalist, v, 749, Dec., 1871.
Spirostrephon cavernarum Cope, Amer. Naturalist, vi, 414, July, 1872.
Spirostrephon (*Pseudotremia*) *cavernarum* Harger, Amer. Journ. Sc. and Arts, iv, 118, 119, Aug., 1872.
Pseudotremia cavernarum Ryder, Proc. U. S. Nat. Mus., iii, 526. Feb. 16, 1881.

Eyes black, conspicuous, forming a somewhat irregular, narrow triangular patch, with from twelve to fifteen facets. Antennæ unusually long and slender, the joints pilose; joints 3 and 5 of the same length, or 3 a little longer; joints 2 and 6 of equal length; joint 7 elongate, pear-shaped, pilose, the extremity truncated, with two or three sense-setæ not so long as the end of the joint is thick.

The first scutum next to the head is scutellate in shape, rounded on the front edge, somewhat produced anteriorly in the middle; the margin behind slightly sinuous; it is about two-thirds as long as broad. The second scutum is a little wider than the first; the third somewhat wider,

while the fourth is much wider; dorsal face of first scutum smooth; the posterior part of the second scutum a little swollen; that of the third more so; that of fourth scutum swollen and ridged much as in fifth and succeeding scuta. Scuta 5–20 are swollen high up on the sides into a shoulder, giving a quadrilateral instead of a circular outline to the segment, bulging out more subdorsally than below; the swelling has six longitudinal ridges, while the posterior swollen end of the scuta above, especially on the posterior half of the body, is coarsely tuberculated, the tubercles being rounded rather than flat, and unequal in size. No well-marked setiferous tubercles on the side from the middle of the body to the head; but on the last six segments there are on each shoulder or scutal swelling two minute rudimentary swellings or tubercles; but in my specimens I can see no setæ except on the two terminal segments of the body in ♂ and ♀, where on the end of the last scuta there is a seta arising from a basal movable joint; there are three pairs on the lateral anal plates (30th segment). Length 18^{mm}; thickness of the body 1.5^{mm}.

The young when about half-grown are white, the back of the antennæ and anterior segments having a very slight dusky tinge. In numerous mature specimens from the Senate Chamber, Wyandotte cave, three miles in, the body is white, with a slight flesh-colored tint. In numerous (150) specimens from this locality, the head and dorsal side of the anterior segments are slightly dusky; the antennæ are also usually slightly dusky, except the two terminal joints, which are white.

There is thus seen to be a slight amount of variation in color in specimens collected at the same date in the same chamber in Wyandotte cave.

Among the 150 specimens taken at one time and place from Wyandotte cave (Senate Chamber) and individually examined, I could see none without black eyes, the pigment being well developed. There was a fair proportion of males.

Four specimens which I collected in Little Wyandotte cave were exactly the same size as those from Great Wyandotte cave; they were white tinged, dusky on the head and fore part of the body. The eyes are black and the eye-patch of the same size and shape, while the antennæ are the same.

Six specimens from Bradford cave, Ind. (which is a small grotto formed by a vertical fissure in the rock, and only 300 to 400 yards deep), showed more variation than those from the two Wyandotte caves. They are of the same size and form, but slightly longer and a little slenderer, especially joints 3 and 5; joint 7 is decidedly longer than in any others; whiter, more bleached. The antennæ are much whiter than in those from the Wyandotte caves, and the head and body are paler, more bleached out than most of the Wyandotte specimens. The eyes vary more than in the Wyandotte examples, one having but 12 facets, another 14, and another 15, with a few minute rudimentary facets between the others. It thus appears that the body is most bleached and the eyes the most rudimentary in the Bradford cave, the smallest and most accessible,

and in which consequently there is the most variation in surroundings, temperature, access of light and changed condition of the air. Under such circumstances as these we should naturally expect the most variation.

Var. *carterensis*. A decided approach to *S. lactarius* is seen in certain brown specimens, only partly bleached, found in the Carter caves, Kentucky, viz. : Bat cave, X cave, and Zwingler's cave, besides a cave across the road from the hotel, which is used as an ice-house.

In the specimens from Bat cave, the antennæ are slightly shorter, and a little slenderer, particularly joints 3–5 ; but joint 7 is much shorter and blunter than in the Bradford cave individuals ; the antennæ, however, are of the same length, though slenderer than those living in Great Wyandotte cave. The eyes form a nearly equilaterally triangular area, with from 23 to 25 facets. The segments behind the head are thirty. They differ from the Wyandotte examples in the posterior or swollen portion being rather more prominent than in the former, forming more marked lateral swellings, with about eight ridges on the side of each boss, and the body is larger and thicker, but the legs are of the same length.

The head is dark in front, mottled above and below with paler horn-color. The antennæ are concolorous with the head and body, but the terminal joints are paler, as are the legs, which are also paler at the articulations. The entire body is dark horn-brown, mottled and irregularly lineated.

The smoother anterior portion of the scuta shows a tendency to be paler than the tuberculated portion, and of a bluish-gray tint. The tubercles are no more prominent than in the Wyandotte individuals.

The segments in both the Wyandotte species and var. *carterensis* rapidly decrease in size, the penultimate segment being pointed, and each segment is provided with regular, high-raised parallel prominent ridges on the shoulder or lateral boss, about 40–45 on a scutum on the sixth segment from the end of the body.

Length 23^{mm} ; thickness 2.5^{mm}, the body being considerably larger and thicker than in the Wyandotte specimens.

Two specimens from X cave are exactly in size and color like those from Bat cave.

Three specimens from the ice-house cave only differ from those in Bat cave in being somewhat paler, but the eyes and antennæ are the same.

A large and a partly grown one from Zwingler's cave was collected by Mr. Sanborn, Aug. 23 ; these were also paler than those from Bat cave. With them were associated a Ceuthophilus with eyes well developed, and Polydesmus.

This form or variety would be, perhaps, mistaken for *Lysiopetalum lactarium*, but it is true in all the generic details to *Pseudotremia ;* at the same time it is what may be called a "twilight" species, living in small caves in situations partially lighted. It is probably derived from *L. lactarium*, or a closely allied species ; we doubt if it will ever be found living in the same situations as *L. lactarium*.

Prof. Cope's types were first found by him in Erhart's cave, Montgomery county, and Spencer Run and Big Stony Creek caves, in Giles county, Pennsylvania; also, in Lost Creek cave, on the Holston river, in Granger county; and in other limestone caves of the valley of the Tennessee. Prof. Cope afterwards (Amer. Nat. vi, 14) discovered this species in Wyandotte cave, remarking, "The species is quite distinct from that of the Mammoth cave, and is the one I described some years ago from caves in Virginia and Tennessee."

CRYPTOTRICHUS,* nov. gen.

Pseudotremia Cope (in part), Proc. Amer. Phil. Soc., xi, No. 82, 180, 1869.

The head seen from in front is wider than long, as usual in the family, but the genæ (or sides above the base of the jaws) are not so much swollen as usual, being much as in *Zygonopus;* the front is broad and not very long, and is distinctly marked by a ridge from the vertex. The eyes are large, well-developed, prominent, and equilaterally triangular. The antennæ are large and slender, much more so than in *Trichopetalum* or *Scoterpes*, but not so long and slender as in *Pseudotremia*. The joints have somewhat the same proportionate length as in the latter genus, but while the second joint in Pseudotremia is about half as long as the third; in *Cryptotrichus* it is much longer, being about two-thirds as long as joint 3; joints 2 and 4 are of the same length, while in Pseudotremia joint 4 is considerably longer than joint 2; joint 5 is a little shorter than joint 3; joint 6 is very short and thick compared with that of Pseudotremia, being about one-third longer than thick, while in Pseudotremia the same joint is over twice as long as thick and regularly clavate; the terminal (seventh) joint is oval, moderately short and thick, about twice as long as thick; regularly oval, with two or three sensory flattened hairs of the usual form.

The body consists of thirty segments, including the lateral anal plates; it is thick and rather short, having the general proportions of Trichopetalum. The setæ being of microscopic size, the segments (scuta) appear to the naked eye to be naked and smooth; each scutum (tergite) is divided into two portions, an anterior plain and a posterior spotted portion, but there are no ridges, and but a single slightly prominent tubercle projecting backwards and situated a little below the middle of the side of the tergite; each of these tubercles, at least on the posterior half of the body, directly sends off a fine seta which is directed backwards. From each of the pale, equidistant spots, extending in a nearly straight line around the posterior edge of each scutum arises a minute hair; the same spots in front give rise to minute conical tubercles.

The legs are long and slender; as long as the body is thick.

No males have been obtained, so that the secondary sexual characters cannot be here given.

* *Κρύπτω*, I conceal; *θρίξ, τριχός*, hair; referring to the minute setæ, difficult to detect.

In describing *S. cæsioannulatus*, forming the type of the genus, Dr. Wood, in his "Myriopoda of North America," p. 194, remarks: "This species ought, perhaps, to be the type of a new genus; but, as I am unable to make out the generic characters in this family, it seems preferable to retain it in this for the present."

The genus may be recognized by its slender antennæ, its smooth scuta, and three transverse rows of setiferous pale dots; in these respects differing from Lysiopetalum and Pseudotremia.

Cryptotrichus cæsioannulatus (Wood).

Spirostrephon cæsioannulatus Wood, Myr. N. Amer., 194, Pl. ii, Fig. 14, 1865.

Pseudotremia vudii Cope, Proc. Amer. Phil. Soc., xi, No. 82, 180, 1869.

Two ♀. Eyes equilaterally triangular, convex, prominent, black. Body horn-brown in color, stained and spotted with darker brown. Head and antennæ concolorous, being dark purplish-brown; antennæ pale at the articulations of the joints. Feet slightly paler than the antennæ, whitish at the articulations. Segments (scuta) dark brown on the posterior edge, with three pale rounded distinct spots on each side, and a fourth spot below, or eight in all; from the centre of these three upper spots, on each side, arise short microscopic setæ. A median pale dorsal impressed line along the whole body, which dilates on the anterior part of each segment into a short, broad diamond-shaped area. The extreme hinder edge is smooth and pale, giving a transversely-banded appearance to the body. In one of the two specimens the lower white dots are, towards the head, more or less confluent, forming an irregular lunate spot. Length 15^{mm}.

Two ♀ specimens were kindly collected for me by Mr. C. L. Herrick, either at Culmana, Ala., or at Ocean Springs, Miss., the bottle containing Myriopods from both those localities. Dr. Wood's specimens were from Allegheny county, Penna.; and Prof. Cope's examples were from Pennsylvania.

This is a rather characteristic form, owing to the transverse series of light dots, and the linear pale transverse line on the hinder edge of each segment, so that the specific name is well chosen. What Dr. Wood is disposed to regard as "pores," appear to be slight tubercles, bearing setæ on the posterior half of the body. I have been thus far unable, with a half-inch objective to detect any repugnatorial pores in this genus or any except Lysiopetalum, but am not disposed to deny their existence. The hairs are minute and mostly rubbed off in alcoholic specimens which have been transported far. My specimens agree so well with Prof. Cope's description that I do not doubt but that his *Pseudotremia vudii* is this species. There seem to be no difference of importance. The dorsal impressed line in my specimens is a faint crease, being neither a "keel" or "groove." Cope remarks that it has twenty-nine segments; his specimen was eleven lines in length.

This Myriopod is a rather characteristic form, and appears to range from Pennsylvania to the Gulf States.

Trichopetalum Harger.

Trichopetalum Harger, Amer. Jour. Sc. Arts, iv, 118, 119, Aug., 1872.

Body rather short and thick, fusiform compared with the succeeding genera, being thicker in the middle and tapering more towards each extremity than in Scoterpes and Zygonopus. Head of the general shape of that of Zygonopus, the proportions of the front and vertex being about the same; but the gena is much fuller, more globose, and the genal area is shorter and rounder. The eyes are present, black, the facets 10–19 in number, arranged in two curvilinear series, the eye-patch being lunate in shape. The antennæ are short and thick, much more so than in Scoterpes, pilose, with a few rather coarser setæ than usual; joint 2 is but slightly more than half as long as joint 3, and rather shorter than joint 4; joint 3 is considerably longer than joint 5, the latter being thick, subpyriform and swollen toward the end; joint 6 is much swollen and rounded, and about as thick as long; the seventh or terminal joint is shorter than in any other genus of the family, being rather shorter than in Scoterpes; and with two flattened sensory terminal setæ. Number of body segments, 28–31; number of pairs of legs in the female, 46. The legs are much shorter than in Zygonopus. The scutæ are posteriorly a little swollen on the sides, much less so than in the two following cave-genera; the bosses being not much over half as large; from the upper part of the boss or shoulder arise three warts or tubercles arranged as usual in a scalene triangle, and giving rise to short, rather stiff setæ, which are half as long as the segment is thick.

In the male the three pairs of legs in front of the genital armature are slightly longer than those behind or in front, but the seventh pair or that directly in front of the rudimentary eighth pair are not swollen, nor do they in any way resemble the swollen pair in Zygonopus. The eighth or rudimentary pair are two-jointed, the outer joint without a claw, only sending off a few small setæ.

The genital armature is somewhat similar to that of Zygonopus, but better developed. I could detect no lateral pores.

Mr. Harger gave the following diagnosis of the genus: "Sterna not closely united with scuta; third and fifth joints of antennæ elongated; scuta furnished with bristles; no lateral pores; eyes present." He does not attempt to give any generic characters drawn from the genitals, and in his description of *T. lunatum*, says: "The under side of the seventh segment of the male (Fig. 3) is furnished anteriorly with a pair of appendages directed backwards and curved upward," and then describes the rudimentary eighth pair of legs. Our description of the genus has been drawn up from Mr. Harger's types belonging to the Museum of Yale College, kindly loaned us for study. On such examination as we could make without dissection, the genital armature is evidently more perfectly devel-

oped than in Zygonopus and Scoterpes, but a number of specimens are needed for dissection before the structure can be clearly made out. The number of segments is 28 in *T. lunatum*; 30 in *T. iulioides*, and 31 in *T. glomeratum*. The genus appears to be distributed from the Atlantic to the eastern slope of the Cascade mountains in Oregon, as well as on the Pacific coast of Oregon.

The following are the known species of the genus which have been described by Mr. Harger:

Trichopetalum lunatum Harger, Amer. Jour. Sc. and Arts, iv, 118, Aug., 1872.* I have found in April several specimens hybernating under leaves at Providence, R. I.

Trichopetalum glomeratum Harg., l. c., 118, 1872. Valley of the John Day river, Oregon.

Trichopetalum iulioides Harg., l. c., 118, 1872. Simmon's harbor, North shore of Lake Superior.

Genus Scoterpes Cope.

Spirostrephon (Pseudotremia) Pack., Amer. Naturalist, v, 748, Dec., 1871.
Scoterpes Cope, Amer. Naturalist, vi, p. 409, 414, July, 1872.

Body very long and slender, not fusiform; consisting of thirty segments besides the head, and with about fifty-two pairs of legs, with the penultimate joint very long. Head rather large, and unusually broad; no eyes present; the genæ unusually large, extending high up on the vertex, but not so globose as in Trichopetalum; the front is also carried farther up on the vertex than usual, and is much broader than long; the clypeus flat, slightly bilobed on the front edge. The antennæ are moderately long and hairy, with the sixth segment scarcely longer than in Trichopetalum, but more uniform in thickness, scarcely longer than thick; the terminal joint as long as the sixth, the end conical, more produced than in Trichopetalum or Zygonopus; at the tip are four rather long sense-setæ. Body segments becoming as usual smaller next to the head; the anterior of each division of the arthromere much swollen high up on the sides; each shoulder with three tubercles, which are arranged in a scalene triangle and bearing much longer setæ than in the other genera, though not quite so long as the body is thick. The legs are long and slender, much more so than in Trichopetalum, and somewhat more so than in Zygonopus. In the male the eighth pair of legs are rudimentary, being two-jointed, the second joint only one-fourth longer than the basal, and ending in a well-developed stout claw. The genital armature minute and very rudimentary, pale, scarcely chitinous; the outer lamina short and thick, with a stout external recurved spine, and two terminal obtuse points; the inner lamina shorter, forming a truncated angular spine, and not much more than half as long as the outer lamina; between the inner and outer lamina, its base next to the inner lamina is a middle spine ending in an irregular tuft of fine spinules.

* Author's extras, published July 13, 1872, New Haven, Conn.

The genus is distinguished from Trichopetalum by its want of eyes, its broader head, its long slender body, with long setæ, by the eighth pair of female rudimentary legs ending in a claw. From Zygonopus it differs in the shorter sixth antennal joint; its broader head; its slenderer legs, the sixth pair in the female not being unlike the others, and by the more prominent shoulders and longer setæ. The species of the two genera are of the same general form and size.

The genus Scoterpes was proposed by Prof. Cope for the present species in the American Naturalist for July, 1872, p. 414. The characters given are the "lack of eyes and of lateral pores;" the absence of the latter having been "asserted by Dr. Packard." Ignorant of the difference between the Mammoth cave blind Myriopod and Lysiopetalum, the latter being the only genus of the family then known, we referred it to that genus (Spirostrephon).

Scoterpes copei Cope.

Spirostrephon (*Pseudotremia*) *copei* Packard, Amer. Nat., v, 748, Dec., 1871.
Scoterpes copei Cope, Amer. Nat., vi, 414, July, 1872.
Spirostrephon copei Harger, Amer. Journ. Sc., iv, Aug., 1872.
Packard, Zoölogy, Edit. 1–3, 1879–81.

About 20 ♂ and ♀ examined. Body white, with no dusky discolorations; 30 segments besides the head in specimens 11^{mm} in length and 52 pairs of legs; in one female individual 8^{mm} long there were 49 pairs of legs, including the eighth or rudimentary pair; in other individuals 6^{mm} long there are 24 segments behind the head. The head is provided with short, fine erect hairs of different lengths, especially on the sides of the genæ. In the absence of a second species, we cannot distinguish all the specific from the generic characters; for minor specific characters the reader is referred to figures to be hereafter published by the Geological Survey of Kentucky.

The males and females are alike in size and form.

The specimens were most abundant in the Labyrinth in Mammoth cave, but also occurred in other localities in the cave. It is also common in Diamond cave, where I collected it, and was discovered by Mr. Sanborn in Poynter's cave, 300 yards from daylight. In one of the specimens from the last-mentioned cave, the antennæ were rather more slender than usual.

The genus *Scoterpes*, and its single species *copei*, appears to be limited to Mammoth cave and the others near, in apparently the same system of caves. It was erroneously reported by me to occur in Weyer's and the Luray caves, as the specimens collected belong to *Zygonopus whitei*. Without doubt the genus is a modified Trichopetalum, which has become longer and slenderer in body, with longer legs and antennæ as well as setæ; whether it is a descendant of *Trichopetalum lunatum* or not is uncertain; it may have descended from a different species; but there seems

to be no reasonable doubt but that it is a modified form of a small hairy Lysiopetaloid form, with antennæ exactly like those of Trichopetalum.

Zygonopus Ryder.

Zygonopus Ryder, Proc. U. S. Nat. Mus., iii, 527, Feb. 16, 1881.

Body rather slenderer than in Scoterpes. The head differs from Scoterpes in being much narrower and higher, the swollen sides or genæ being much less swollen; the vertex is swollen; the front as broad as long with the upper edge a little hollowed, but quite distinct from the vertex itself. The eyes entirely wanting, as in Scoterpes. The antennæ are rather thick, and in this respect approach Scoterpes, but the sixth and seventh joints are much longer, and rather more setose; the sixth joint is about two-thirds as thick as long, and the last (seventh) joint nearly twice as long as thick. The sides of the segments are swollen subdorsally as in Scoterpes, and the setiferous tubercles are arranged as in that genus, but the setæ are shorter; the lower posterior edges of the arthromeres below the shoulder or hump is chased obliquely with fine impressed lines. The feet are less in number than in Scoterpes. The diagnostic characters of the genus lie in the remarkably swollen sixth pair of feet of the male, in which the second joint is rather thick, while the third joint is long, and with the fourth joint remarkably swollen, with a series of about nine oblique retractor muscles diverging from the proximal end of the terminal joint, which is long and slender and straight, with a well-developed claw. The seventh pair of the male are of the normal form. The rudimentary or eighth pair are like those of Trichopetalum, the second (terminal) joint not ending in a claw, thus differing from those of Scoterpes. The male genital armature is entirely unlike that of Scoterpes, though it is rudimentary and minute; the outer lamina consists of a basal subtriangular portion, ending in a long slender curved spine, beneath which is a stouter spine, shorter and less curved; a minute median setose lamina is present, while the inner lamina is a weak, slender setose filamentary outgrowth.

Mr. Ryder's generic characters are stated very briefly, as follows: "Sixth pair of legs very robust, and with the third joint greatly swollen." The generic characters are not contrasted with those of Scoterpes.

This genus differs from Scoterpes in the remarkably swollen, clasping sixth pair of legs, and in the male genital armature, while either sex differs from Scoterpes in the much narrower head, and longer sixth and seventh antennal joints.

Zygonopus whitei Ryder.

Spirostrephon copei Pack., Amer. Nat., xv, 231, March, 1881.
Zygonopus whitei Ryder, Proc. U. S. Nat. Mus., iii, p. 527, Feb. 16, 1881.

Eight ♂, 10♀. Body white, long and slender, number of segments 32. Head with scattered, fine setæ; antennæ with the second joint not quite one-half as long as the third, which about equals the fifth in length, both

being rather long; the sixth is thick, barrel-shaped, not quite one-half as long as the fifth, but scarcely thicker; the seventh joint is unusually long, a little more than three-fourths as long as the sixth joint; the end thick and well rounded, with the usual tactile large flattened setæ; the 3–7th joints with long dense setæ, a few in the end of joint 5 longer than any on joints 6 and 7. The setæ on the body arise from tubercles arranged as usual in a scalene triangle, and the setæ themselves are half as long as the body is thick; they are considerably shorter and finer than in Scoterpes.

The number of pairs of legs in the male is 47 in a specimen 8^{mm} in length, in the female there are 48 pairs. The sixth pair of legs of the male are somewhat longer and much swollen, the suture between joints 3 and 4 is very slight, the two joints together forming an ovate section of the leg a little thicker than the length of the second joint; terminal joint long and slender, considerably longer than joints 3 and 4 together. The 2-jointed eighth rudimentary pair of legs are longer and larger than in *Scoterpes copei*, the basal joint nearly twice as long, while the second (terminal) joint is larger and swollen, and besides being larger, ends in three or four fine minute setæ, instead of a short claw, as in Scoterpes. Length 8^{mm}.

The male genital armature is very minute and rudimentary, and has already been described in a general way; with but one species as yet known, it would be unsafe to assign their specific characters. The two inner laminæ are quite unequal in length and development, and the armature in general shows signs of degeneration, as though the species had originated from some form in which the male armature was more completely developed. Nine specimens were found by us in New Market and Luray caves, and about twenty in Weyer's cave, Virginia; Luray cave, Virginia (Dr. C. A. White, Ryder).

This species in size and general appearance would be easily mistaken for *Scoterpes copei*, which we at first, from a too hasty examination, supposed it to be. Mr. Ryder's excellent description characterizes the species, but his figures are indifferent, the third joint of the male is much more swollen in our specimens; and the normal leg (his fig. 3) is drawn too slender, while the front of the head is not correctly rendered. In our specimens drops of a yellowish secretion were attached in alcoholic specimens to the base of many of the setæ, indicating the presence of repugnatorial glands, though no pores could be found. On breaking the body in two nearly ripe eggs occurred in June; they were rounded, oval; length about $\frac{1}{3}$^{mm}.

NOTE ON THE GENUS CAMBALA OF THE FAMILY JULIDÆ.

Cambala Gray.

Julus Say, Journ. Acad. Nat. Sc. Phil., ii, 103, 1821.

Cambala T. E. Gray, Griffith's Cuvier's An. King, xiv, Insecta, i, pl. 135, fig. 2, 2a, 2b, 2c, no descr., 1832.

Reasia R. Jones, Todd's Cyclop. Anat. Phys., Art. Myriopoda, 546.

Cambala Gervais, Newport, Annals and Mag. Nat. Hist., xiii, 266, 1844.
Aptères, iv, 137, 1847.
Spirobolus (in part) Wood, Mgr. N. Amer., 212, 1865.
Cambala Cope, Proc. Amer. Philos. Soc., xi, No. 82, 181, 1869.

The essential, diagnostic characters of this genus are the linear eyes, the long slender body, with keeled scutes; while the antennæ are short and thick, much as in Spirobolus.

The body consists of 59 segments; the scutes with high keel-like ridges. The eyes are arranged in a linear row of ocelli, forming a straight line situated far behind the insertion of the antennæ, next to the front edge of the first segment. The front of the head is somewhat longer than broad; the surface full and convex as in Julus. Antennæ are short and unusually thick, more so than in Julus or Spirobolus; 7-jointed, joint 2 a little longer and thicker than 3; fourth shorter and more clavate than third; fifth rather thicker at end than fourth, but of about the same length; sixth thicker than any of the other, about as long as fifth; seventh very short, round, no longer than broad. The feet are slender, not quite so long as the body is thick. On the fourth lower large ridge is a whitish microscopic spot, which under a half inch objective is seen to be a short acute tubercle; these are Say's "stigmata," but they occur on each segment, and are doubtless homologous with the setiferous tubercles in Trichopetalum, etc.

The only species known has been mistaken for *Lysiopetalum lactarium* by Newport, Gray and Gervais, hence the synonymy of the two genera is somewhat confused. Newport, adopting Mr. T. E. Gray's *MS.* name *Cambala*, was the first to characterize the genus, remarking, "I have derived the characters of this genus from the specimens originally sent by Say to Dr. Leach." It is probable that Say by mistake sent an example of his *Julus annulata* instead of a *L. lactarium*, as the two species would be easily confounded, although his *Julus annulatus* must have been of course familiar to him. The mistake was a natural one.

CAMBALA ANNULATA (Say) Cope.

Julus annulatus Say, Journ. Acad. Nat. Sc. Phil., ii, 103, 1821.
Cambala lactarius T. E. Gray, Griffith's Cuvier's Animal Kingdom, pl. 135, fig. 2, 2a, 2b, 2c. Insecta i, Vol. xiv, Vol. ii, 784, 1832.
Cambala lactaria Newport, Annals and Mag. Nat. Hist., xiii, 266, 1844.
Cambala lactarius Gervais, Ann. Soc. Entom. France, 1844.
Aptères, iv, 137, 1847.
Spirobolus annulatus Wood, Myr. N. Amer., 212, 1865.
Cambala annulata Cope, Proc. Amer. Phil. Soc., xi, No. 82, 181, 1869.
Trans. Amer. Ent. Soc., iii, 66, May, 1870.

Body very long but blunt at the end, consisting of fifty-nine segments besides the head; eyes consisting each of six ocelli arranged in a straight line. The first segment behind the head is smooth, about half as long as wide,

evenly convex, considerably broader than the head; the three succeeding segments are of about the same length, and each are about half as long as the fifth and succeeding segments. On the first segment are about ten bead-like tubercles seen from above; on the third about eight longer tubercles can be seen from above; on the fifth and succeeding segments there are about nine dorsal and subdorsal high, prominent, thick, parallel ridges, becoming sharp behind. On the middle segments of the body about six sharp ridges with broad hollow valleys between can be seen from above. These are mounted on each side lower down by about twelve less distinct ridges, becoming towards the lower edge of the scuta less and less convex and distinct, until they are indicated by simple impressed lines. There are thus about thirty ridges in all on each scute. The segments (arthromeres) are short, and the smooth spaces between the rigid portions are very short above. The color of the body is horn-brown, the head, feet and antennæ pale flesh-colored, and there is a dark median spot on the vertex between the eyes. The ridges are darker than the rest of the body. Length 30^{mm}.

Little Wyandotte cave, Indiana; and Cave of Fountains next to Weyer's cave, Virginia (Packard), Zwingler's cave, Carter's cave, Kentucky (F. G. Sanborn). Spruce Run cave in the Kanawha river, Giles Co., Va. (Cope). One of the most abundant of the Myriopoda in the mountain region of Tennessee and North Carolina (Cope).

This species is not unfrequently found in caverns, where *L. lactarium* more rarely occurs. This well-marked species may readily be distinguished from *Lysiopetalum lactarium* by the very short, thick antennæ, linear eyes, and by the slenderer body, which, however, ends much more obtusely. We know of but one other species of Julidæ with the eyes arranged in a linear series; this is the *Trachyjulus ceylonicus* Peters of Ceylon, figured by Humbert.

The cave specimens which we have found are partially bleached, the result of probably a limited number of generations in the darkness.

On the Morphology of the Myriopoda. By A. S. Packard, Jr.

(*Read before the American Philosophical Society, June 16, 1883.*)

The following notes have reference to the hard parts especially of the diplopod Myriopods:

The Head. In the Chilognaths, which are the more primitive and in some respects the lowest group of the sub-class, the Pauropoda excepted, the structure of the head is on a much simpler type than in the Chilopoda.

The epicranium constitutes the larger part of the head; it may be regarded as the homologue of that of hexapodous insects. Of the clypeus of Hexapoda there is apparently no true homologue in Myriopods; in the Lysiopetalid Chilognaths there is, however, an interantennal clypeal re-

gion slightly differentiated from the epicranium and forming the front of the head. In the Chilopods there is no well-marked clypeus; only a short, narrow transverse preantennal clypeal region to which the labrum is attached. Meinert, in his valuable and pains-taking work on Myriopods designates what we here call the epicranium, the *lamina cephalica;* the division sometimes indicated in front next to the antennæ, he calls *lamina frontalis discreta.*

The labrum in the Chilognaths is a short, but broad, sclerite, very persistent in form, and not affording family or generic characters; it is emarginate on the sides, with a deep median notch containing three acute teeth. The labrum may on the whole be regarded as homologous with that of the Hexapoda, but is very broad and is immovable. Very different is the so-called labrum of the Chilognaths, in which it consists of two parts, a central portion which may be homologized with the labrum of the Chilognaths, but is narrower, with a deep broad median notch at the bottom of which is a central stout tooth.

In *Orya barbarica* Gerv., according to Meinert, the labrum has a median suture, dividing it into two pieces, each with numerous fine teeth on the outer edge.

In *Dignathon microcephalum* Lucas (Meinert. Tab. ii, fig. 15), and in *Geophilus sodalis* Bgs. and Mein., Meinert figures and describes the labrum as consisting of *pars media* and two *partes laterales*, distinctly separated by suture; no such differentiation as this is known to us as occurring in the labrum of Hexapods.

This labrum is flanked on each side by a transverse sclerite, much broader than long; these pieces may be called the *epilabra;* to the outer edge of each is attached the cardo of the so-called mandible (*protomala*). What we have for brevity called the *epilabra* (fig. 1) are the "laminæ fulcientes labri" of Meinert.*

The so-called mandibles of the Myriopods are the morphological equivalents of those of insects, but structurally they are not homologous with them, but rather resemble the lacinia of the hexapodous maxilla. For this reason we propose the term *protomala* (*mala*, mandible) for the mandible of a myriopod; *mala* would be preferable, but this has already been applied by Schiödte to the inner lobes of the maxilla of certain Coleopterous larvæ.

The protomala consists of two portions, the *cardo* and *stipes*, while the hexapodous mandible is invariably composed of but one piece, to which the muscles are directly attached, and which corresponds to the stipes of the myriopodous protomala. The stipes instead of being simply toothed, or with a plain cutting edge, as in Hexapoda, has, in the Chilognaths, two

* Myriapoda Musaei Haurinensis. Bidrag til Myriapodernes Morphologi og Systematik. Ved Fr. Meinert, af "Naturhistorisk Tidsskrift," 3 R. 7 B., Kjöbenhavn, 1871, p. 105. See Tab. i, fig. 4. Meinert states that the laminæ fulcientes do not belong to the labrum itself, and that the form of these pieces varies greatly according to the species.

outer unequal long teeth; and within, a series of singular processes like stout setæ edged with dense spines on the inner side. This double apparatus of teeth and spinose processes, which may be called the *pectinella*, gives the stipes a decided resemblance to that of the hexapodous maxilla. In the Chilopoda, according to the figures and description of Meinert, there is a greater variation in the nature of the pectinella of the stipes. As we have observed in the protomala of Scolopendra and Lithobius, there are three or more stout teeth, with an inner series of spinulated slender processes; but in several genera figured by Meinert, as *Mesocanthus albus* Mein., *Scolioplanes crassipes* ,Koch, *Chætechelyne vesuviana* Newp., *Geophilus sodalis* Bgs. and Mein., and *Mecistocephalus punctifrons* Newp., the cutting edge is provided with spinose processes alone.

For the second pair of mouth appendages of the Myriopoda we propose the term *deutomala*, or second pair of jaws. They form the so-called labium of Savigny and later authors. In the Chilognaths they have a superficial resemblance to the labium of winged insects; but the corresponding pair of appendages in Chilopoda are not only unlike the labium of Hexapoda, but entirely different in structure from the homologous parts in Chilognaths. The "labium" of Newport, or first maxillæ of Meinert, have been described and figured by those authors, to whose works the reader is referred.

The following remarks apply to the homologues of these parts in the Chilognaths. While most authors designate this pair of appendages as the "labium," Meinert more correctly calls them the first maxillæ, briefly in the Latin abstract of his "Danmark's Chilognather"* in his diagnosis of the order describing them as "*Stipites maxillares* appendicibus instructi, detecti;" but in his description of Julus referring to them as "Lamina labialis parva, stipites labiales modo partim sejungens."

Meinert also describes what he designates as a third pair of mouth-parts, or *labium*, which is enclosed by the second pair, behind which is a triangular plate (*lamina labialis*) which he regards as a sternal part, corresponding to the mentum of insects. He then adds: "In front of the labium in the Polydesmidæ are two short round styles (*stili linguales*), which are toothed at the end." He also speaks of the curved piece behind the laminia labialis, which he designates as the *hypostoma* (see our fig. 2).

It should be observed that Savigny states that the labium (lèvre inférieure) is in Julus composed of what he designates as the first and second maxillæ; his second maxillæ being Meinert's *labium*.

It seems to us that the researches of Metschnikoff† on the embryology of the Chilognaths (Strongylosoma, Polydesmus and Julus) leave no doubt that these myriopods have but two pairs of mouth-appendages, which Metschnikoff designates as mandibles and labium. The latter arises as a pair of tubercles or buds, at first of exactly the form of the man-

* Naturhistorisk Tidsskrift. 3 R. 5 B.

† Embryologie der doppeltfussigen Myriapoden (Chilognatha), Von Elias Metschnikoff. Zeitschrift für Wissenschaft. Zoologie, xxiv, 253, 1874.

dibles, and like the primitive embryonic mouth-appendages of any arthropod. Hence the differentiations of parts and coalescence of the two limbs, while closely resembling that of the labium or second maxillæ of hexapods, really occur in Myriopods in a different pair of appendages, *i. e.*, the second instead of the third pair. Hence the parts called labium (many authors) in Myriopods are really homologous with the first maxillæ of insects; and they should, to prevent misconception, receive a distinctive name (deutomalæ). With the aid, then, of embryology we have arrived at a clearer conception of the homologies of the second pair of mouth-appendages in the Chilognaths. It forms a broad flat plate, becoming the floor of the mouth, and forming an under lip; it is differentiated into two sets of broad plates, an outer and inner stipes; the outer stipes (*stipes exterior*) bears at the free edge two movable toothed appendages, which may be designated as the inner and outer *malellæ*. The inner stipes (*stipes interior*), are united firmly, and are supported behind by what Meinert designates as the *lamina labialis*, behind which is a curved, broad sclerite called by Meinert the hypostoma; a rather unfortunate name, as it has been used by Meigen and Bouché for the clypeus of Diptera. Differentiated from the front edge of the inner stipes, is a piece usually separated by suture, which, as we understand it, is the *stilus lingualis* of Meinert; it is our *malulella*. A median portion of the deutomala has been apparently overlooked by authors; it is our *labiella* (fig. 2), and corresponds in a degree to the lingua of hexapods; it is a minute rounded piece situated between the malulellæ; in Julus minute and single; in the Lysiopetalidæ much larger, and divided into a large anterior, and a much smaller posterior crescent-shaped part; it is supported by two long cylindrical divaricating styles.

It thus appears that the head of Chilognaths bears but three pairs of appendages, viz., the antennæ, and the mouth-appendages, the proto and deutomalæ. Without doubt the Chilognaths, as proved by their embryology and morphology, and their close relationship with the Pauropoda, the simplest Myriopods, represent the primary form of the Myriopods, while the Chilopods are a secondary, less primitive group. Palæontology apparently supports this view. We may now turn to the structure of the head of Chilopod Myriopoda, which has been fully described by Newport,* and also by Meinert.†

Having already briefly described the morphology of the epicranium or antennal segment of Chilopods, with the labrum and "mandibles" (protomalæ = "true maxillæ" of Newport), which are close homologues of those of diplopod myriopods, we may next take up the second pair of mouth-appendages, which are the morphological equivalents of the so-called labium of Chilognaths. These, as seen in Scolopendra, are very different

* Monograph of the class Myriopoda, Order Chilopoda; with Observations on the general arrangement of the Articulata. By George Newport, Trans. Linn. Soc., xix, p. 287.

† Myriapoda Musæi Hauniensis Bidrag til Myriapodernes Morphologi og Systematik ved Fr. Meinert. Af Naturhistorisk Tidsskrift, 3 R. 7 B., 1871.

from the so-called under lip of Chilognaths; they are not united, and are separate, cylindrical, fleshy, 5-jointed appendages, but as Newport states "connected transversely at their base with a pair of soft appendages (*c*, *c*). that are situated between them, and which, as I have already stated, I regard as the proper *lingua*, as they form the floor of the entrance to the pharynx." These 5-jointed appendages are Mr. Newport's "maxillary palpi;" his true maxillæ being the homologues of the "mandibles" of Chilognaths.

The portion of the head of Scolopendra and other Chilopods, thus far considered, together with the antennæ and proto and deutomalæ, we consider as homologous with the entire head of Chilognaths; the basilar segment of Newport, and the two pairs of head-appendages have no homologues in the head of Chilognaths. They are rather analogous to the maxillipedes of Crustacea, and nothing like them, speaking morphologically, exist in other Tracheata. We therefore propose the term *malipedes* (*mala*, jaw; *pes*, foot, or jaw-feet) for the fourth and fifth pair of cephalic appendages of Chilopoda. At the same time it is easy to see that they are modified feet; especially when we examine the last pair in Scolopendra, which are attached to a true sternite, and see that they are directly homologous with the feet and sternite of the same animal.

The first pair of malipedes are the "labium and palpi" of Newport; the "first auxiliary lip" of Savigny. They, however, bear little resemblance to an insect's labium and labial palpi. They are separate, not coalescing in the middle as in the labium of Hexapods. The so-called labial palpi are 4-jointed, with an accessory plate. They arise directly in front of the "basilar segment" of Newport, but appear to have in adult life no tergite of their own.*

The second pair of malipedes or last pair of mouth-appendages, are the poison fangs; they are the "second auxillary lip" of Savigny; the "mandibles or foot-jaws" of Newport and subsequent authors. The dorsal plate, or what may be called the *second malipedal tergite* is the "basilar and subbasilar plate" of Newport.

As to the number of segments in the head of Chilognaths, both morphology and embryology prove that there are but three; in the Chilopoda five. Newport's observation on the young recently hatched Geophilus (his Pl. xxxiii, fig. 3), shows that the sub-basilar plate is the tergum or scute of the fifth segment; and the basilar plate is consequently the tergum of the fourth segment, or second malipedal segment. The sternite of the sub-basilar plate is usually a very large plate, deeply indented in front in the middle, with teeth on each side, and forms the "labium" of Newport. It may for convenience in descriptive zoölogy be termed the "pseudolabium."

* Balfour also states, as we find after writing the above, that the basilar plate is really the segment of the poison claws, and may fuse more or less completely with the segment in front and behind it, and the latter is sometimes without a pair of appendages (Lithobius, Scutigera) Comp. Embryology, i, p. 225.

As embryological proofs of our morphological views may be taken the admirable researches of Metschnikoff* on the development of Geophilus. His Taf. xx, fig. 4, shows plainly the four pairs of mouth-appendages behind the antennæ, the latter developed as in Hexapods from the procephalic lobes. His fig. 15 shows that the pleurum and tergum of two posterior (or fourth and fifth) cephalic arthromeres, with their appendages, are the primitive scuta of the proto and dentomalar arthromeres which at this period have coalesced, and are intimately united with the procephalic lobes. His fig. 18 shows that at a later period the primitive scuta of the fourth cephalic segment has disappeared, or at least is merged into the fifth primitive scuta or sub-basilar plate of the adult. An examination of Metschnikoff's paper will prove conclusively that Newport's views as to the sub-segments of the chilopods are not well founded in nature; and that they are merely for the most part simply adult superficial markings.

The following table will serve to indicate, in a comparative way, the number of arthromeres in the head of the three sub-classes of Tracheate arthropods, their corresponding appendages, and the more important synonyms:

	Hexapoda.	Arachnida.	Myriopoda. (Chilopoda.)	Myriopoda. (Chilognatha.)
1st Arthromere (Preoral)	Antennæ.	Wanting.†	Antennæ.	Antennæ.
2d Arthromere (Postoral)	Mandibulæ.	Cheliceræ.‡ (Mandibles.)	Protomalæ. (Mandibles Savigny.)	Protomalæ. (Mandibles Savigny.)
3d Arthromere	1st Maxillæ.	(Pedipalpi, maxillæ.)	Deutomalæ. (1st Maxillæ Savigny.)	Deutomalæ. (Labium.)
4th " ..	2d Maxillæ.	1st pair of bæ-nopoda.	1st Malipedes. (1st Auxiliary lip, Savigny.)	2d pair of Pedes.
5th " ..	.....	2d pair of bæ-nopoda.	2d Malipedes. (Auxiliary lip, Savigny; Mandibles.)	2d pair of Pedes.
6th " ..	1st pair of bæ-nopoda.	3d pair of bæ-nopoda.	1st pair of Pedes	3d pair of Pedes.

General Morphology of the Body. The well-known researches of Newport on the development of Julus, and the embryological studies of Metschnikoff already referred to, show that the larva of Julus and other diplopod myriopods is hatched with but three pairs of feet. In *Julus terrestris*, as stated by Newport, the 3d body-segment is apodous; the 1st, 2d and 4th segments behind the head bearing feet. The number of body-segments are at first 9; the new segments appearing six at a time. In Strongy-

* Embryologisches, über Geophilus. Von Elias Metschnikoff. Zeitschrift für Wissenschaft. Zoölogie, xxv, p. 313, 1875.

† Balfour claims that the 1st pair of cephalic apppendages are wanting; and the fact shown by his Fig. 200 C, D, that the stomodæum at first lies between the procephalic lobes, and that the latter do not even bear appendages appears to prove his statement.

‡ On the Organs of Reproduction and the Development of the Myriopoda Phil. Trans., 1841.

losoma, according to Metschnikoff, the larva has eight segments behind the head, the second segment footless ; in Polydesmus there are but seven body-segments, the second apparently being apodous, though it is difficult to determine with certainty from the drawing which of the three first segments is apodous.

In two embryos of *Julus multistriatus* Walsh? kindly communicated to us by Prof. Riley, and which he assures us were freshly hatched right from the egg, the larvæ are much more advanced than in the freshly-hatched larvæ referred to ; still *the second body-segment is footless instead of the third;* but there are seventeen segments, the 1st, 3d and 4th each bearing a single pair of legs ; the 5th–10th segments each bearing two pairs of legs. In one of the three specimens, which was apparently a little longer out of the egg than the two others, there were five penultimate short secondary segments (11th–15th) on which there were rudiments apparently of but a *single pair of legs* to each segment, whereas Newport states that two pairs bud out from each segment, and while in *Julus terrestris* the new segments arise in sixes, in our species they arise in fives. In adult life a single pair of limbs arises from the second segment, and the first three segments each have but one pair of legs, the fourth having two as in the fifth and following segments.

It thus appears that the larval diplopod Myriopod is a six-footed Tracheate, though neither its mouth-parts nor primary legs are directly homologous with those of the Hexapodous insects.

Looking at the embryo diplopod Myriopod from a deductive or speculative point of view, it doubtless represents or is nearly allied to what was the primitive myriopodous type, a Tracheate, with a cylindrical body, whose head, clearly separated from the hind body, was composed of three cephalic segments, one pair of antennæ, succeeded by two postoral arthromeres, the protomalal and deutomalal arthromeres ; while the hind body consisted of as few as seven arthromeres, whose scuta nearly met beneath, with three pairs of six-jointed legs distributed among the first four segments. It is evident that the form represented by the adult is a secondary later product, and arose by adaptation to its present form. The embryo Geophilus, the only Chilopod whose embryology has been studied, leaves the egg in the form of the adult ; it has, unlike the diplopods, no metamorphosis. Its embryological history is condensed, abbreviated.

But in examining Metschnikoff's sketches, primitive Chilognath characters assert themselves ; the body of the embryo shortly before hatching is cylindrical ; the sternal region is much narrower than in the adult, hence the insertion of the feet are nearer together, while the first six pairs of appendages (the sixth apparently the first pair of feet of the adult) are indicated before the hinder ones. These features indicate that the Chilopoda probably arose from a diplopod or diplopod-like ancestor, with a cylindrical body, narrow sternites and with three pairs of legs, which represent those of the larval Chilognaths, the two anterior becoming the two pairs of malipedes of the present Chilopoda. Thus the first six appendages of the

embryo Geophilus correspond to the antennæ, two pairs of mouth-parts and three pairs of legs of the larval Julus.

The phenomenon of two pairs of limbs to a segment, so unique in Tracheata, may be explained by reference to the Phyllopoda among the Branchiata. The parallel is quite exact. The larvæ in both groups have but a single pair of appendages to a segment; the acquisition of a second pair in the diplopods is clearly enough a secondary character, and perhaps necessary in locomotion in a cylindrical body with no sterna.*

The larval Julus and the ancestral Chilognaths were hexapod Tracheata, but sufficiently different to indicate plainly that the Myriopods branched off from a much more primitive form than the Scolopendrella-like hexapod ancestor, and which form somewhat agrees with our hypothetical leptiform ancestor of all Tracheata.

The Myriopods also differ from Hexapoda in that the genital armature of the male (the females have nothing corresponding to the ovipositor of Hexapoda) is not homologous with that of true insects; moreover, the armature is not homologous with the limbs or jointed appendages of the myriopodous body. On the contrary, the apparatus of hooks arises from the sternum of the sixth segment, between, but a little in advance of the origin of the eighth pair of legs. It should be observed that the legs in Myriopods are outgrowths between the tergites and sternites, there being no pleurites differentiated, and in this important point also, the myriopods are quite unlike the Hexapodous Tracheates.

Affinity and systematic position of the Pauropoda. The nearest living forms which approaches the larval Diplopod are Pauropus and Eurypauropus. These organisms are practically primitive diplopods. Looking at the lowest Chilognath, *Polyzenus*, and comparing Pauropus with it, it will be seen that the latter scarcely differs from it ordinally. Pauropus has a head with a pair of antennæ and two pair of mouth-appendages, The antennæ are quite unlike any other myriopods, being 5-jointed and bifurcate, somewhat as in certain Coleopterous larvæ; the peculiar sense-filaments may be the homologues of the flattened sense-setæ at the end of the antennæ of Diplopod Myriopods.

The "mandibles" are rudimentary, very simple, and are scarcely more like Chilopod than diplopod protomalæ; there is a second pair of appendages which, as Lubbock states, are "minute and conical;" they bear a closer resemblance in position and general appearance to the "under lip" of Chilognaths, especially the under lip of Siphonophora; in fact, the

* It is plain that, as Balfour suggests, Comparative Embryology p. 324, the double segments have not originated from a fusion of two primitively distinct segments. There is, however, a misconception as to the nature of the "double segments." They are not so in fact. The scutes are single, undivided, but the ventral region is alone imperfectly double, bearing two pairs of appendages, just as single segments of Apodidæ may bear from 2-6 appendages; the differentiation is confined to the ventral limb-bearing region and limbs alone; the dorsal part of the segment does not share in the process.

mouth-appendages of Pauropus are much nearer the normal type of those of the true Chilognaths than the degraded mouth-organs of the Sugentia.

The body of Pauropus is cylindrical, the scutes are as much like those of Polyxenus as those of the Chilopods; the number of body segments is seven, the same as in the larvæ of certain Diplopods; the feet are 6-jointed as in Diplopods, and there are nine pairs, six pairs to the four penultimate segments. The three anterior pairs are developed from two segments, *i. e.*, arise from the ventral and lateral sclerites corresponding to two scutes. This fact should not, we venture to suggest, exclude them from the Chilognaths, as there is a considerable irregularity in the positions of the three pairs of anterior feet in larval Chilognaths. The terminal body-segment is much as in Chilognaths. When we examine the larva of Pauropus, we find a strong resemblance to the larval hexapodous Chilognaths. Hence we scarcely see good grounds for placing Pauropus in a distinct order from Chilognaths. Their distinctive characters, and they are important ones, are we submit, only of subordinate value, and we should therefore place the Pauropoda as the second sub order of Chilognaths, throwing all the genuine Chilognaths into a first sub-order.

Turning to Eurypauropus, we find that this singular form is in a degree a connecting link between Pauropus and Polyxenus; the head has much the same shape, the antennæ being inserted beneath far back from the front edge of the broad top; the legs are much the same shape, and more truly diplopod than in Pauropus, as they are arranged nearly in two pairs to a segment; there are six segments, four of them bearing legs, there being nine pairs of legs to four scuta. The scutes are much as in Polyxenus, spreading out flat on the sides, the animal being elliptical oblong, broad and flat. There are no true sternites like those of Chilopods, and though the feet are inserted wider apart, the entire structure of the soft, membranous sternal region is much as in Polyxenus. We therefore feel warranted, although originally accepting the ordinal rank of the Pauropoda, assigned them by Sir John Lubbock, in regarding them as Chilognaths, with aberrant features which would throw them into a suborder of the latter group.

The Systematic Position of Scolopendrella. This singular form is usually regarded as a Myriopod, while Mr. Ryder refers it to a distinct order, *Symphyla*. We have already* given our reasons for the view that it is a Thysanuran,† with only superficial resemblances to the Chilopod Myriopods. Our fresh studies on the latter confirm our opinion that the Scolopendrella is a hexapod. The mandibles and maxillæ, the former especially, are like those of the Thysanura, rather than the myriopods, not being divided into two parts (stipes and cardo). It seems to us that Scolopendrella with its numerous postcephalic legs may fulfill the

* American Naturalist, xv, 698, Sept. 1881.

† Compare the excellent figures of the mouth-parts of Scolopendrella in Dr. I. Muhr, Die Mundtheile in Scolopendrella und Polyzonium, 10er Jahresbericht über das Deutsche Staats Gymnasium in Prag-Altstadt, 1881-2. Prag. 1882.

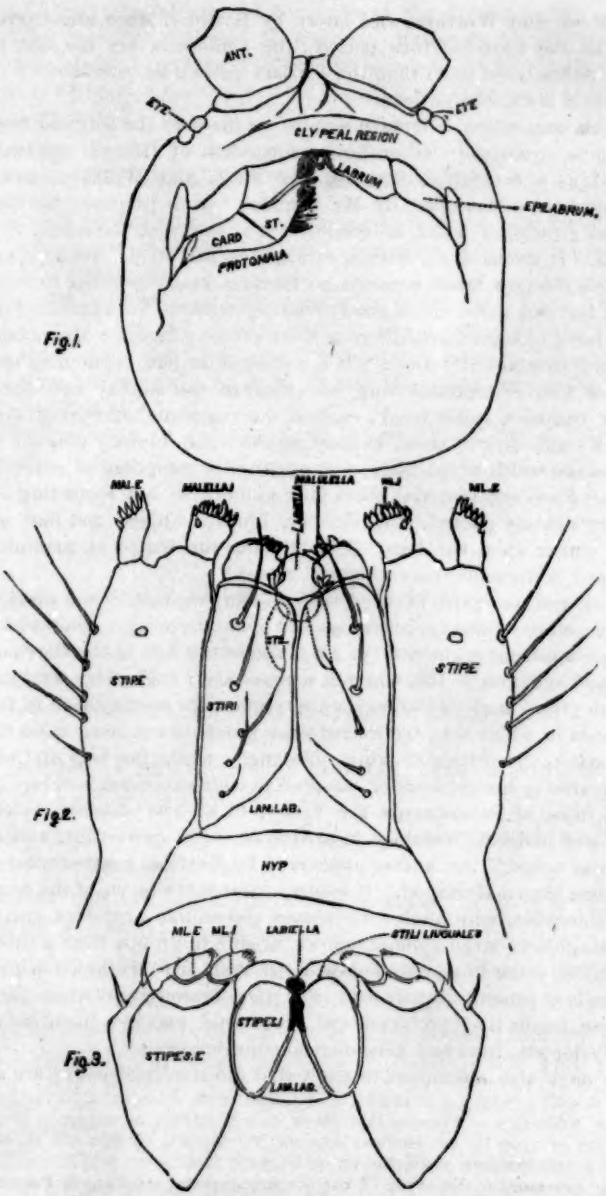
phylogenic requirements of the early embryo of Hexapoda and Arachnida in which there are a number of embryonic primitive abdominal appendages. Thus it preceded Campodea as a stem-form.

Genealogy of the Myriopoda. The pseudo-hexapodous larval forms of Chilognatha, including the Pauropoda and the early germ of the Chilopoda (Geophilus), indicate that the many-legged adults were derived from what we have called a Leptus-form ancestor. Our present knowledge of the embryology of the Myriopoda shows that unlike the Arachnida and Hexapoda the embryo is not provided with primitive, transitory legs. There seems then no direct proof that the Myriopoda had an origin common with that of insects and arachnida, from a Scolopendrella-like, and perhaps still earlier Peripatus-like ancestor; but from a six-legged form, which, however, may have been derived from some worm-like ancestor. The Leptus-form larva of Myriopoda, with their three pairs of cephalic appendages and six legs, may, then, be the genealogical equivalent of the six-legged Nauplius of Crustacea; which type is generally believed to have originated from the worms.

A genealogical tree of the Myriopods would then be simply two branches, one representing the diplopod and the other the single paired type (Chilopoda), both originating from a Leptus-like six-footed ancestor (*i. e.*, with three pairs of cephalic and three pairs of postcephalic appendages).

Dr. Erich Haase in his "Beitrag zur Phylogenie und Ontogenie der Chilopoden" publishes a "stammbaum der Protochilopoden." He proposes a hypothetical group, Protosymphyla, from which the Symphyla, Thysanura and Chilopoda have originated. But, as we have seen, this view is based on mistaken views as to the relations of the Chilopods to the diplopod Myriopods, and of the homologies of Myriopods with insects. As we have seen, the Chilopods must have originated from a Chilognathous stock, or at least from a branch which arose from Pauropus-like forms, and the Thysanura, with Scolopendrella, must have arisen from a separate main branch, which led to the Hexapodous branch of the Arthropod genealogical tree.

For the reason stated, also, we should disagree with the views of Haeckel (Naturliche Schöpfungsgeschichte, 1870, 2d edit.) that the Diplopod Myriopods were derived from the Chilopoda. In the English transaction (1876) he remarks. "But these animals also originally developed out of a six-legged form of Tracheata, as is distinctly proved by the individual development of the millipede in the egg. Their embryos have at first only three pairs of legs, like genuine insects, and only at a later period do the posterior pairs of legs bud, one by one, from the growing rings of the hinder body. Of the two orders of Centipedes * * * * the round *double-footed* ones (Diplopoda), probably did not develop until a later period out of the older flat, *single-footed* ones (Chilopoda), by successive pairs of rings of the body uniting together. Fossil remains of the Chilopoda are first mentioned in the Jura period." The Chilognaths, however, as shown by Daw-



MOUTH-PARTS OF MYRIOPODS.

son, Meek and Worthen, and lately by Scudder, were numerous as far back as the Carboniferous period; the Chilopods are the later productions; perhaps not older than the Tertiary period, since Munster's *Geophilus pravus* is a doubtful form.

In this connection, reference should be made to the singular fossil, Palæocampa, from the Carboniferous formation of Illinois, originally described as a caterpillar-like form by Meek and Worthen, and lately claimed to be a Myriopod by Mr. Scudder,* who proposes for the hypothetical groups, of which he considers it as the type, the name, *Protosyngnatha*. It seems to us, after a careful reading of Mr. Scudder's article, that this obscure fossil presents no features really peculiar to the Myriopods; but that there are as good or better reasons for regarding it as the hairy larva of some Carboniferous neuropterous insect. Mr. Scudder describes it substantially thus: "It is a caterpillar-like, segmented creature, three or four centimeters long, composed of ten similar and equal segments, besides a small head; each of the segments, excepting the head, bears a single pair of stout, clumsy, subfusiform, bluntly-pointed legs, as long as the width of the body, and apparently composed of several equal joints. Each segment also bears four cylindrical but spreading bunches of very densely packed, stiff, slender, bluntly tipped, rod-like spines, a little longer than the legs. The bunches are seated on mammillæ and arranged in dorsopleural and lateral rows."

We do not recognize in this description any characters of a myriopodous nature; on the contrary, in what is said about the head, "composed of only a single apparent segment" (p. 165), and of the legs in the above description, and again on p. 165, where it is remarked: "The legs were different in form [from modern Chilopoda], but their poor preservation in the only specimen in which they have been seen, prevents anything more than the mere statement of the following difference; while the legs of Chilopoda are invariably horny, slender, adapted to wide extension and rapid movement, those of Palæocampa are fleshy, or at best subcoriaceous, very stout and conical, certainly incapable of rapid movement, and serving rather as props," the author appears to be describing rather a caterpillar-like form than a Myriopod. It seems to us that the larvæ of the neuropterous *Panorpidæ*, with their two-jointed abdominal prop-legs, small head and singularly large spinose spines, arising in groups from a tubercle or mammilla, come nearer to Palæocampa than any Myriopod with which science is at present acquainted. For these reasons, and while the nature of these fossils is so problematical, we should exclude them, as regards the Myriopods, from any genealogical considerations.

We have also attempted to show that the *Archypolypoda*† are a subdi-

* The Affinities of Palæocampa Meek and Worthen, as evidence of the wide diversity of type in the earliest known Myriopods, by Samuel H. Scudder. Amer. Journ. Science, xxiv, No. 141, p. 161, Sept., 1882.

† The Systematic Positions of the Archipolypoda, a Group of Fossil Myriopods. Amer. Naturalist, 326, March, 1883.

vision of Chilognaths, allied not remotely to the Lysiopetalidæ; or at least that they are true diplopod Myriopods. Hence we are still reduced for our materials for a phylogeny of the Myriopods to existing orders, Pauropus being, perhaps, a more aberrant and stranger type than any fossil forms yet discovered.

EXPLANATION OF THE FIGURES.

Fig. 1. Head of Scolopendra, seen from beneath, showing the "mandible" (*protomala*) with its cardo (*card.*) and stipes (*sti.*), also the labrum and epilabrum.

Fig. 2. So-called under lip or deutomala of *Scoterpes copei; hyp.*, "hypostoma;" *lam. lab.*, lamina labialis; *stip. e.*, stipes exterior; with the *malella exterior* (*mal. e.*) and *malella interior* (*ml. i.*); the *stipes interior* (*stip. i.*), with its malulella; and the *labiella*, with its stilus (*stil.*).

Fig. 3. The deutomala of *Julus* sp.; the lettering as in Fig. 2. Author del.

Stated Meeting, May 18, 1883.

Present, 9 members.

President, Mr. FRALEY, in the Chair.

Dr. Heilprin, a newly-elected member, was introduced to the presiding officer, and took his seat.

A letter requesting a renewal of correspondence was received from the Egyptian Institute.

Letters of acknowledgment were received from the Royal Societies at Amsterdam and Munich.

Letters of envoy were received from the Egyptian Institute, and the Royal Academy at Munich.

Letters requesting No. 95 from the Manchester Literary and Philosophical Society, April 26; and requesting 102, 103, 104, from the Philadelphia College of Pharmacy, April 20, were read and referred.

Donations were received from the Egyptian Institute; Central Observatory at St. Petersburg; Royal Geological Insti-

tute and Anthropological Society at Vienna; Royal Academy and Observatory at Munich; the National Verein, at Bonn; Société de Géographie and Revue Politique at Paris; Société de Géographie Commerciale at Bordeaux; Royal Academies at Modena and Bruxelles; the Geographical and Geological Societies and London Nature; Literary and Historical Society of Quebec; Boston Natural History Society; Prof. C. A. Young; Numismatic, Antiquarian and Zoölogical Societies, at Philadelphia; the Library of Congress, Bureau of Education, Engineer Department, and the Philosophical Society, at Washington; the Chicago Historical Society; and the Brazilian School of Mines.

Photodynamic Notes, No. VIII, by Pliny Earle Chase, were read by title.

A note on the relic of the native flora of Pennsylvania, surviving in Perry county, by Professor E. W. Claypole, was read by the Secretary, and specimens of the plant, *Vaccinium brachycerum* Mich., were exhibited.

Minutes of the last meeting of the Board of Officers and Members in Council were read.

Mr. Fraley reported that, after conference with Dr. Brinton, he could recommend to the Society to accept the proposed gift. On motion, the recommendation was approved and adopted. (See MS. minutes.)

Pending nominations, Nos. 985, 986, and new nominations, Nos. 987 to 1004, were read.

A Committee of Five, to co-operate with other Societies in extending an invitation to the A. A. F. A. S. to hold their meeting of 1884 at Philadelphia, was appointed, consisting of Dr. Brinton, Dr. Barker, Mr. Lesley, Mr. Henry Phillips, Jr., and Mr. Wm. M. Davis. On motion of Dr. Frazer, the Committee was requested to ascertain if measures can be taken to secure the fixing of a date for the meeting of the Geological Congress at Berlin such as would permit those who have participated in the A. A. F. A. S. meeting to be present at the Congress.

And the meeting was adjourned.

Stated Meeting, June 16, 1883.

Present, 5 members.

President, Mr. FRALEY, in the Chair.

Letters of acknowledgment were received from the Royal Academy at Lisbon (109, 110, 111), and Royal Academy at Amsterdam (109).

Letters of envoy were received from the Royal Academy at Lisbon, June, 1882; the Museum Teyler; the Société Hollandaise, March 30; the Royal Academy at Amsterdam, March 1; and the Surgeon General's Office, Washington, June 6.

Letters from M. J. Vidal, at Cairo; M. Gaston Planté, Paris; Dr. A. S. Packard, Jr., Providence, R. I.; Edmund Goldsmid, of Edinburgh; and Mr. A. R. Grote, of Buffalo, were read.

Donations for the Library were received from the Academies at Amsterdam and Rome; the Societies at Salem, Boston and Worcester; the Trigonometrical Survey of India; the Holland Society, and Museum Teyler; Dr. G. D. E. Weyer, of Kiel; the Geographical Societies at Paris and Bordeaux; Revue Politique, and Ecole des Mines; British Association, Victoria Institute, Royal Astronomical, and Antiquarian Societies and London Nature; Canadian Institute; Cambridge Museum; Medical Journal; New York Observatory; Rutger's College; Franklin Institute, Historical Society, College of Pharmacy, H. Phillips, Jr., and Dr. P. Frazer; American Chemical Journal; Smithsonian Institution, National Museum, Engineers' Department, Bureau of Education and Fish Commission; Wabash College; Medical Journal, at Indianapolis; and the Ministerio de Fomento.

The death of Col. Robert S. Williamson, at San Francisco, Nov. 11, 1882, was announced by Dr. Horn.

The death of the Hon. Judge George Sharswood, at Philadelphia, May 28, 1883, aged 73, was announced by Mr. Fraley.

Dr. A. S. Packard, Jr., of Providence, R. I., communicated, through Prof. Cope,—

1. A revision of the *Lysiopetalidæ*, a family of Chilognath myriopoda; with a notice of the genus *Cambala*. (See page 177, 195.)

2. On the Morphology of the *Myriopoda*, with a plate. (See page 197.)

Mr. A. R. Grote, of Buffalo, communicated: An Introduction to the North American *Noctuidæ*. (See page 134.)

Pending nominations, Nos. 985 to 1004, were read.

And the meeting was adjourned.

Stated Meeting, July 20, 1883.

Present, 4 members.

Curator, Dr. HORN, in the Chair.

Letters of acknowledgment were received from the Royal Library, Berlin (112); the Würtemberg V. N. V. (109, 110, 111); the Prague Observatory (107, 108, 109); New Hampshire Historical Society (113), Essex Institute (113), American Antiquarian Society (113), Rhode Island Historical Society (113), Connecticut Historical Society (113), W. D. Whitney (113), New Jersey Historical Society (113), Buffalo Society of Natural Science (113), W. B. Taylor (113), Theodore Gill (113), Wisconsin State Historical Society (113), and Georgia Historical Society (113).

Letters of envoy were received from the Society of Sciences at Bordeaux, the Hungarian Academy, Lisbon Academy, Belgian Ministry of Foreign Affairs, and Institut Ethnographique at Paris.

Donations for the Library were received from the Royal Academies of St. Petersburg, Berlin, Vienna, Buda-Pest, Munich, Brussels, Lisbon; from the Societies at Bremen, Emden, Batavia, Stuttgard, Bordeaux, Dublin; from the Observato-

ries at Prague, Offenbach, Geneva, New York; from the Royal Museum at Brussels; Geographical, Anthropological and Ethnological Societies at Paris and Bordeaux; Revue Politique, Annales des Mines, Musée Guimet, Revista Euskara, Royal Astronomical Society, Museum at Rio de Janeiro, New Zealand Institute, Boston Natural History Society, New Bedford Library, Yale College, Brooklyn Library, Prof. Guyot; Franklin Institute, College of Pharmacy, Library Company; Peabody Institute, United States Naval Institute, Smithsonian Institution, National Museum, Bureau of Interior, and Fish Commission.

The death of Prof. Stephen Alexander, at Princeton, N. J., June 25th, aged 76, was reported.

The death of Prof. Charles E. Anthon, at New York, in June, aged 60, was reported.

The death of Major-General Sir Edward Sabine, in England, about May 28, aged 95, was reported. (See London Nature for July 5, p. 218.)

The election for new members was postponed to October 19th.

And the meeting was adjourned.

Stated Meeting, August 17, 1883.

Present, one member.

Curator, Mr. HENRY PHILLIPS, Jr.

Letters of acknowledgment from Harvard College Library (112); the Wyoming Historical and Geological Society (113); the Royal Academy at Copenhagen (110, 111); Mr. Phillips (113), and the Numismatic and Antiquarian Society of Philadelphia (113).

Letters of envoy from the R. Accademia dei Lincei, the Geological Survey of India, the Royal Society at Liège, the Cambridge Philosophical Society, and the Musée Guimet.

Donations to the Library from the Indian Survey; Royal Society at Tasmania; Imperial Academy at St. Petersburg; Imperial Society at Moscow; Imperial Geological Institute at Vienna; German Geological Society, Berlin; Royal Academy, Brussels; Statistical Bureau, Stockholm; Antiquarian Society, Copenhagen; Royal Academy and Observatory at Turin; Accademia dei Lincei, and Geological Committee at Rome; International Geological Congress at Bologna; Geographical Society, Annales des Mines and Revue Politique at Paris; Geographical Society, Bordeaux; Revista Euskara; Nautical Almanac, Barcelona; Scientific Expedition, Lisbon; Royal Institution, Victoria Institute, Royal Astronomical Society, Royal Geographical Society, Meteorological Society, Geological Society, Royal Asiatic Society, and London Nature; John B. Lawes, of Herts, England; W. J. O'n Daunt, of Dublin; Museum of Comparative Zoölogy, Cambridge; American Journal of Science; New York Observatory; C. A. Barratoni, Ed. of Travel, N. Y.; Franklin Institute, Academy of Natural Science, American Journal of Pharmacy, and Prof. E. D. Cope; the Wyoming Historical and Geographical Society; American Chemical Journal and Journal of Mathematics; National Academy of Sciences; Polytechnic Society of Kentucky, Louisville; State Library of Natural History, Illinois; American and Oriental Journal; and Museo Nacional.

And the meeting was adjourned.

Stated Meeting, September 21, 1883.

Present, 3 members.

President, Mr. FRALEY, in the Chair.

A letter was received from Mr. J. B. Lawes, dated Rothumstead, Herts, England, July 31, 1883.

Letters of acknowledgment were received from the Astronomico Observatorio Nazional de Faenbaya, Mexico (113);

Prof. J. J. Stevenson (113); and the Cambridge University (109).

Letters of envoy were received from the Prussian Academy, Swiss Society, Belgian Statistical Bureau, Musée Guimet, Institut d'Ethnographie, Greenwich Observatory, and United States Coast Survey.

A letter requesting information was received from the United States Signal Service Bureau.

A letter requesting the completion of their set of Transactions of the American Philosophical Society was received from the London Statistical Society. So ordered.

A letter proposing full exchanges from the beginning was received from the United States Geological Survey, Washington, D. C. So ordered.

Donations for the Library were received from the Prussian, Bavarian, Belgian, Turin, Modena and Madrid Academies; from the Institutes at Venice and Philadelphia; from the Adelaide, Greenwich, Radcliffe, Yale and New York Observatories; from the Statistical Bureaus at Stockholm and Brussels; from the Societies at Hanover, Glarus, Leipsig, Görlitz, Lausanne, Leeds and Boston; from the Historical Societies at New York and Newark; from the Geological Societies at Vienna, London, Glasgow and Dublin; from the Geographical Societies at Paris, Bordeaux and London; from the Zoölogical Societies at Paris and London; from the Antiquarian Societies at Paris, London and Worcester; the Ethnographical and Anthropological Societies at Paris, the Society of Americanists, Ecole Politechnique, Bureau des Longitudes, M. Loewy, and the Revue Politique; the Musée Guimet; Revista Euskara; Expedition Serra Estrella; Office of Mines, Victoria; London Nature; Canadian Naturalist; American Journal of Science; American Journal of Pharmacy; Pennsylvania Magazine of History and Biography, the Engineers' Club, Dr. Hugh Hamilton, Dr. Charles W. Dulles, and Mr. Henry Phillips, Jr., of Philadelphia; Johns Hopkins University and the University of Virginia; the United States Naval Institute; the Smithsonian Institution, United States Board of Engineers, Signal

Service, Coast Survey, National Museum and Fish Commission; C. O. Thompson, of Terre Haute; Dr. Ladislaus Netto, George Basil Digwell, and the State Geological Survey of Illinois.

The death of John C. Trautwine, at Philadelphia, September 14, 1883, aged 74, was announced by the Secretary.

The following communications were read:

From Prof. E. W. Claypole, New Bloomfield, Perry county, Pennsylvania:

1. On a large *Crustacean* from the Catskill rocks of Meshoppen, Wyoming county, Pa., in the collection of Mr. Lacoe, of Pittston, Pa., with a small photograph of the head; a plaster cast of which was exhibited.

2. On the genus *Rensselaeria* in the Hamilton group, in Perry county, Pa.

3. On the equivalent of the New York *Portage*, in Perry county, Pa.

From Prof. E. D. Cope, a letter to the Secretary, dated Sully Springs, Dakota, Sept. 7, 1883, was read, as follows:

"I have the pleasure to announce to you that I have within the past week discovered the locality of a new lake of the White River epoch, at a point in this Territory nearly 200 miles north-west of the nearest boundary of the deposit of this age hitherto known. The beds, which are unmistakably of the White River formation, consist of greenish sandstone, and sand-beds, of a combined thickness of about 100 feet. These rest on white calcareous clay, rocks and marls, of a total thickness of 100 feet. These probably also belong to the White River epoch, but contain no fossils. Below this deposit is a third bed of drab clay, which swells and cracks on exposure to weather, which rests on a thick bed of white and gray sand, more or less mixed with gravel. This bed, with the overlying clay, probably belongs to the Laramie period, as the beds lower in the series certainly do.

"The deposit as observed, does not extend over ten miles in north and south diameter. The east and west extent was not determined.

"The fossils, which indicate clearly the age of the formation, are the following:

PISCES.

Rhineastes, sp. nov.	2
Aminurus, sp. nov.	

LACERTILIA.

Sp. indet. 1

TESTUDINATA.

Trionyx, sp. .....
Trionyx, sp. 3
Stylemys, sp. .....

RODENTIA.

Castor, sp. 1

CARNIVORA.

Galecynus gregarius .....
Hoplophoneus, sp. 3
? *Hoplophoneus*, sp. .....

PERISSODACTYLA.

Aceratherium, sp. .....
Aceratherium, sp. 3
Anchitherium, sp. .....

ARTIODACTYLA.

Elotherium ramosum .....
Hyopotamus, sp. .....
Oreodon, sp. .....
Oreodon, sp. 7
Oreodon, sp. .....
Leptomeryx, sp. .....
Hypertragulus, sp. .....

Total species 20

"Interesting features of the above catalogue are: The absence of Hyracodon and Poëbrotherium, so abundant in the beds of this age elsewhere; the presence of fishes, not hitherto detected in them; and the presence of the genus of tortoises, *Trionyx*. The latter genus has not hitherto been found in our Western lacustrine beds of later than Eocene age; while they are abundant in our modern rivers. This discovery partially bridges the interval. The same is true of the fishes mentioned, which represent the order Nematognathi."

From Mr. Joseph Lesley, a letter to the Secretary, dated Princeton, Mass., August 22, was read, and specimens of seeds exhibited which had germinated between blocks of ice in the ice-house attached to the hotel of Mr. Edwin Grimes.

"In 1882 Mr. Grimes noticed that seeds, which had been dropped in packing the ice, had thrown out stems and roots. In the winter of 1882–'83, he experimentally scattered seeds of rye, barley and wheat be-

tween the cakes. To-day (Aug. 23) I was called to look at some of the results, and I send you a rough drawing of one of the germinated rye seeds. You will notice that the roots pushed out laterally between two blocks of ice; the shoot, or stem, did the same for half an inch, but then turned upwards at a right-angle and penetrated the solid ice vertically for a distance of two inches.

"No matter how the seed lay, whether with its germinating point up, down or sideways, the growth was always in the true vertical through the solid ice.

"I have seen, in 1882 and 1883, at least fifty similar cases occurring in this ice-house."

Pending nominations, Nos. 985 to 1004, and new nominations, Nos. 1005, 1006, were read.

The President reported that he had received, and paid over to the Treasurer, $132.75, being the interest on the Michaux rentes, last due.

And the meeting was adjourned.

The Perry County Fault. Note on an important Correction in the Geological Map of Pennsylvania. By E. W. Claypole.

(Read before the American Philosophical Society, April 20, 1883.)

THE DISTRICT IMMEDIATELY SOUTH OF NEW BLOOMFIELD.

The country lying immediately south of Mahanoy ridge, is one of the best collecting grounds that I have found in the county for the fossils of the Hamilton and Chemung groups. The Upper Hamilton shales are there exposed better than I have found them elsewhere, and the Chemung, especially the lower part of the group, may also be examined in many small wayside cuts and field-exposures.

But very soon after beginning to work this field I became aware that some difficulty hitherto unrecognized stood in the way of deciding the horizon from which the fossils came. It was impossible to recognize the different rocks according to the views expressed in the preliminary map of Perry county. References to this geological map of the county will show that the ground between Mahanoy ridge and Dick's hill is there represented as a close syncline bounded by outcropping edges of Hamilton sandstone, the middle of which is occupied by a sheet of Chemung rocks. But a very short examination sufficed to show that the Hamilton Upper shales extended much farther out into the valley from Mahanoy ridge

The New Bloomfield fault.

Fig. 1.

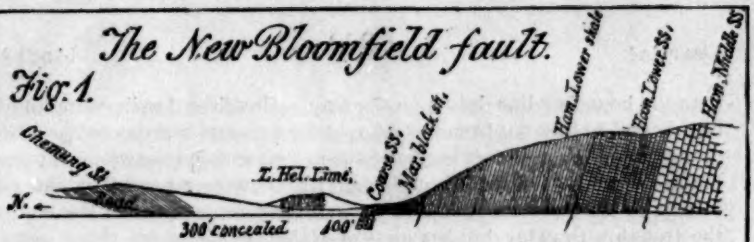


Fig. 2.

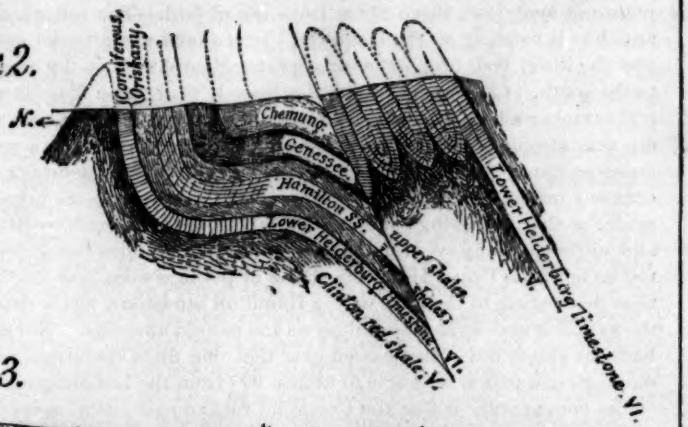


Fig. 3.

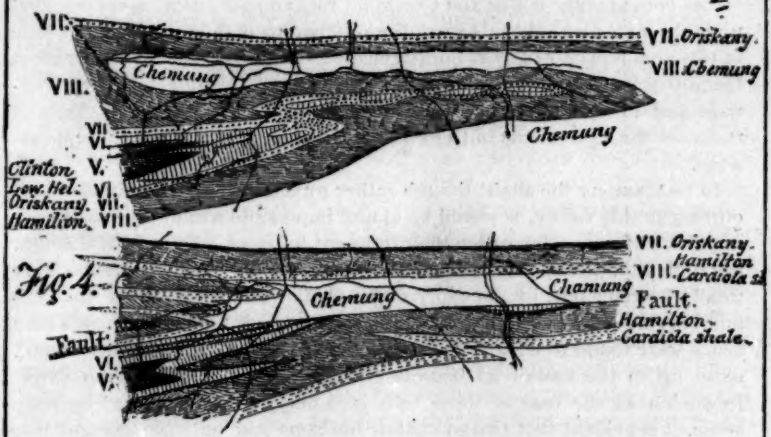


Fig. 4.

Fig. 1. Cross-section of the faulted district.
Fig. 2. Diagrammatic section across the fault.
Fig. 3. Copy from the published map of Perry Co.
Fig. 4. Corrected representation.

F. 2.

than the bounding line drawn on the map. Hamilton fossils were found farther and farther out from the ridge in the grounds represented as Chemung on the map, until it become evident that in the western part of the basin or trough the Hamilton Upper shales were repeated by the extension to the eastward of one of the anticlines represented at the end of the trough. Crawley hill is a mass of Hamilton sandstone rising immediately to the south of the township road running to Little Germany at a point not more than three miles from Bloomfield. The influence of this anticline is to bring up the Hamilton Upper shales again to the surface so that the lower beds crop out at or near the school-house on the branch road to the south. Continuing along the branch road these Hamilton shales still occupy an immense space, far more than their thickness, and yet they dip very steeply. Another anticline, running up from the south-west, produces another repetition. The crest of the Hamilton Sandstone ridge which encloses on the east the Perry Furnace valley throws up the upper shales again, so that in passing south, about half a mile from the New Bloomfield and Little Germany road, one passes over two anticlines rising first to the top layer of the Upper Hamilton shales or perhaps even into the Genesee, then descending to the edge of the Hamilton sandstone, again rising over the syncline and again descending on the second anticline. Nor is it until both the ridges have been passed over that one finds the strata regularly dipping outwards at an angle of almost 90° from the last anticlinal axis.

The consequence is that the Chemung rocks do not occur, as represented upon the map, along the middle of the eastern part of the valley. The whole of this area is occupied by Hamilton shales. The area, colored to represent Hamilton rocks on the map, between the roads leading to Perry Furnace and to Gibson's rock is occupied by rocks of later date. Most of them are the equivalents of the Portage-Chemung, very similar in appearance.

In fact, among the slight though rather numerous exposures of shale occurring in this valley, it would be almost impossible without the assistance of palæontology to determine their different horizons. Even with this aid, the difficulty, although diminished, is not removed. Many of the beds are totally barren; but, by the study of the fossils yielded by others the folds and varying angles of dip were followed out and Chemung fossils and rocks were found to occupy the whole southern side of the Middle basin, close up to the foot of its bounding range, Dick's hill and Iron ridge. Inasmuch as the base of these hills is in many places occupied by limestone, it is evident that two so distant horizons can only be brought into contact by a fault.

Following the various roads out of New Bloomfield it is not difficult to trace this fault through the county.

No. 1. The Ridge road to Carlisle. On this line the successive formations occur in regular sequence from New Bloomfield for about two and one-half miles, when the ground suddenly changes from Chemung shale to Lower Helderberg limestone.

No. 2. Old road to Carlisle. The same result is obtained along this line. At about two miles from New Bloomfield is a small roadside cutting showing Chemung shale and at about one hundred yards further on is an indistinct but manifest Oriskany ridge. Between the two is a narrow strip of Lower Helderberg limestone.

No. 3. West road to Gibson's rock. At about two miles and a half from New Bloomfield, the lower Portage bed (Cardiola shale) dipping at nearly 90° crops out on the roadside, and within one hundred yards the road passes over the Oriskany sandstone (near Mr. S. Brown's).

No. 4. Road to Montebello narrows. This road, running almost due east, passes over a great distance of Chemung shales rising to a higher horizon than along either of the roads already mentioned. But on turning to the south at the entrance to the narrows two cuttings, only one hundred and fifty yards apart, show the Chemung shales and the lower Helderberg limestone.

No. 5. Road from Perry Furnace to Gibson's rock. The old Perry Furnace lies upon the lower Helderberg limestone. The Oriskany sandstone does not make any conspicuous ridge along this road. But at a few hundred feet south of the Furnace the base of the Hamilton sandstone is seen and passing through the narrows its upper limit may be easily detected. Following this at a distance of about four hundred feet comes in the Oriskany sandstone, forming a distinct ridge of rocks. The fault therefore comes through in this interval, bringing the Lower Helderberg limestone in contact with the Hamilton Upper shale. The throw here is less than farther east, not exceeding 1650 feet measured at right angles to the beds, or 2300 feet if measured vertically.

No. 6. Road to Losh's run (Polecat road and Ohio Wharf road). This road strikes the line of fault about six miles east from New Bloomfield. The exposures are not quite so striking as in the places already mentioned, but the fault is equally conspicuous. Chemung shales occupy the ground south from Mahanoy ridge to Dick's hill with, so far as can be determined, a tolerably uniform dip of about 40°. Immediately at the northern foot of Dick's hill the lower Helderberg limestone is quarried. Though no cutting showing the shales can be seen close to the quarry, yet the surface of the fields shows the presence of the Chemung sandstone, and, from the color, it is apparently nearer the top than the bottom of the group. Some indications also are present, which seem to show that the yellow shales and brown sandstones of the beds underlying the limestone, are brought up into contact with the Chemung. The throw of the fault here is consequently greater than at any one of its western exposures, amounting, if measured square across the beds, to about 4650 feet, or vertically 6510 feet.

Westward of the lines hitherto followed the fault may be traced. It cuts off the Hamilton sandstone of South Furnace ridge, which declines in consequence to the general level of the country. This extinction of the Hamilton Sandstone ridge takes place about two miles south-west of the

Perry Furnace. It cuts through the Oriskany ridge, almost at the point where the two outcrops are about to meet, and passing out of the Oriskany near the high point behind Adam's Glen school-house, near Landisburgh, cannot be followed through the monotonous red shale, of which the valley consists. There is, however, no ground for supposing that it continues into the Blue mountains, no traces of displacement being visible in Kennedy's valley or on Pilot Knob.

Eastward beyond the display near Montebello narrows, described above, the fault continues, and its investigation becomes difficult. After leaving the exposure at No. 6, which is about a mile east of the narrows, and where the throw is greatest, it suddenly diminishes. The Hamilton sandstone which has been faulted up and has formed the monoclinal ridge of Dick's hill, suddenly sinks and vanishes underground. The land being low it is not easy to find evidence of its presence, but sections along the river and in Watts township show that it continues to Half Falls mountain.

From the facts that have been collected the only possible conclusion is that the fault here doubles itself and rapidly diminishes. The line already traced continues nearly along the course of Losh's run and forms the most southern of the four separate ranges of Hamilton sandstone, which together form Half Falls mountain. About the meridian line on which the sudden descent of the Hamilton sandstone takes place and Dick's hill disappears, a subsidiary fault develops itself about half a mile northward, near the end of Mahanoy ridge and continues to and across the river where it throws up a third ridge of Hamilton sandstone immediately south of the second and nearly equaling it in height.

These two minor faults—extensions of the Perry County fault—run westward along the range of Half Falls mountain to a distance which it is not possible to determine without a greater expenditure of time than the other work on the county would justify. The southern fault probably has but a short range, but the northern not improbably runs for two or three miles.

The fault here described is thus shown to be one of no trifling extent, having been traced in the above notes about eighteen miles along its outcrop from E. N. E. to W. S. W. The changes which it renders necessary on the map are considerable. The whole outcrop of the Hamilton rocks ranging along the north side of Dick's hill must be canceled and its place occupied by Chemung shales. The great patch of Chemung shales in the western end of the valley must be replaced by Hamilton and the Hamilton by Chemung. These changes may be seen in a moment by comparing two sketch maps accompanying this paper with one another. The narrow middle valley of Perry county is not a syncline but a monocline. Half of it has been removed and elevated above the level of the rest, from which height it has been washed by atmospheric action and swept into the Atlantic.

The mass of material thus removed will be evident when the diagram shown below is compared with the maps and with the figures showing the amount of "throw" of the fault. This section, though not

drawn minutely to scale is yet sufficiently accurate for our present purpose. It occurs at Montebello narrows about four miles from New Bloomfield and shows what would be seen, if the exposure of the rocks permitted, along the whole course of the fault. The details, such as the amount of throw and the horizons brought into juxtaposition, would vary to some extent, but these variations do not in any way affect the principle.

The fault is indicated on the surface only by a slight and interrupted depression, not in any way noticeable; but along at least a part of its course it is marked by a line of strong springs. So evident is its course, when the structure of the county is understood, that a man can stand with one foot on the Chemung shales and the other on the Lower Helderberg limestone.

Throw.—In estimating the throw of this fault it must be remembered that it is not everywhere of the same extent. At its greatest the olive shales of No. 8, the Chemung, are brought into contact with the limestone of No. 6, the Lower Helderberg. If we then calculate the throw where it is greatest we shall get the following results. The part of the Chemung appearing at the surface at the fault is as near as I can determine about 2000 feet above the base of that group, including the Portage:

			Feet.
Partial	thickness of	Portage-Chemung (lower portion)	2000
Total	"	" Genesee shale	200
"	"	" Hamilton Upper shale	300
"	"	" Hamilton sandstone	600
"	"	" Lower Hamilton shale	500
"	"	" Marcellus Black shale	100
"	"	" Marcellus limestone and shale	50
"	"	" Oriskany sandstone and shale	100
Partial	"	" Lower Helderberg limestone	200
Total	"	" rocks thrown by the fault	4050

This, within certain small limits of error, is the amount of throw calculated at right angles to the bedding. The total dislocation is, however, much greater. The tangential or horizontal thrust, to which is due the folding of the Appalachian strata and their accompanying or subsequent fracture, forced the the rocks on the S. E. side of the fault over those on the N. W. side, along a slope whose angle cannot be determined. It has been represented in the section at 45°, but was probably less. If the amount above given be now increased in the proportion of the sine of this angle to the radius, or multiplied by about 1.4, we shall obtain as the actual displacement of the strata along the line of the fault about 5600 feet.

The Little Germany Fault.

Further investigation has developed another fault parallel to the first and at the distance of about a mile to the northward.

It develops itself near the hamlet of Little Germany, in Spring township, and runs east-north-east into Centre for nearly five miles. Though

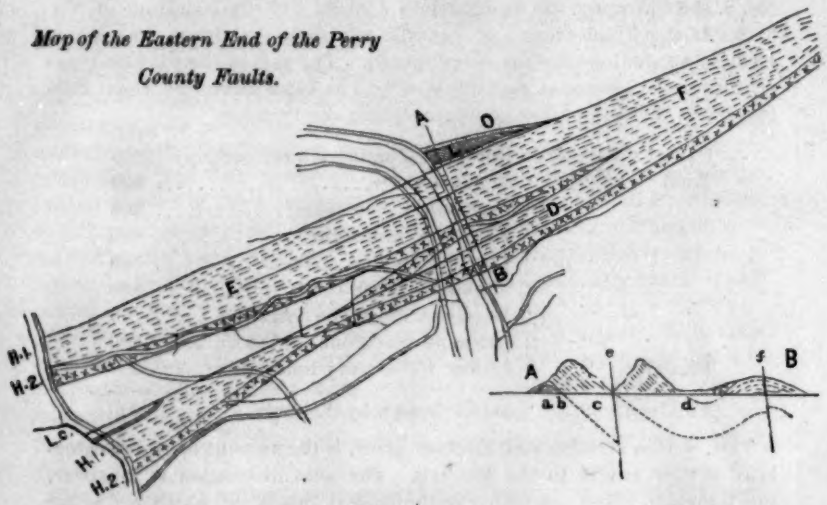
far inferior in length and throw to the Perry County fault it yet produces much complication and several noteworthy changes in the topography and landscape.

The most westerly point at which I have been able to detect the fault is on the hill west of Little Germany, where it produces a fork in the Oriskany sandstone, one ridge continuing on its previous course, while the other diverges slightly to the southward. The latter thrown up by the fault is cut off at a short distance, the ridge terminating in a field.

In thus bringing up the Oriskany to the surface, the dislocation has also brought up the Lower Helderberg limestone adjoining it, and the result is that limestone has been quarried and burnt at one place, while at the distance of about 100 feet northward, or geologically speaking *below* it, lies

FIG. 5.

Map of the Eastern End of the Perry County Faults.



H. 1. Hamilton sandstone and Lower shale.
H. 2. Hamilton Upper Shale.
O. Oriskany, &c.
L. Limestone.
E. F. Fault.
C. D. Fault.

the Marcellus Black shale with no intervening Sandstone ridge. The Marcellus thus occurs on *both* sides of the narrow belt of limestone. Following the line of fault a little farther to the east, we find the Lower Hamilton shale brought up on the south side against the Marcellus on the north, and farther yet the lower shale, about 500 feet thick, occupies both sides of the fault. As we approach the township line, which lies on the watershed parting the south fork of Montour run from the tributary of the Little Juniata, a high connecting ridge of Lower Hamilton shales rises on the south side of the fault, exposing the Marcellus at its base, into which a tunnel six feet square in section has been driven in search of coal.

The north side is occupied by the Hamilton sandstone, through which the fault here cuts obliquely and the throw having increased it causes a lateral displacement of nearly a mile, through which the road passes from the Lower to the Upper shale without crossing any Sandstone ridge.

Entering Centre township, the fault passes along the strata as they rise to the Crawley arch, leaving the synclinal west end of Mahanoy ridge separated from the anticlinal east end of Crawley hill. The latter is so far eroded as to expose the Hamilton Lower shale for more than two miles from Little Germany.

The throw is greatest near the watershed on the township line, where the lower part of the Lower Hamilton shale is brought up against the Upper Hamilton shale and may be estimated thus:

Upper Hamilton shale (part)	150 feet.
Hamilton sandstone	600 "
Lower Hamilton shale (part)	400 "
	1150

But as the beds dip at about 45°, the actual vertical displacement is more, being in proportion to the sine of the angle of dip. This will give 1600 feet. The Little Germany fault extends into Centre township almost to Bloomfield, gradually dying out. But it may be traced by a slight valley, and by the increased thickness of the Hamilton Upper shale, as far at least as the residence of Mr. William Brunner. Its total length is about four and a half miles.

Intermediate Fault.

Yet further in this connection, a third fault of small dimensions passes between the two above described. Manifesting itself near the house of Mr. George Meck, it causes a repetition of the Hamilton sandstone, bringing the middle and upper beds to the surface after they have dipped south from the Crawley anticline.

This fault is of no great extent, apparently disappearing in a mile and a half. Nor is its throw more than about 200 or 300 feet. But it makes a distinct short ridge of Hamilton sandstone, and a deep intervening valley between it and Crawley hill.

N. B.—In consequence of the discovery of this third dislocation, a slight correction is rendered necessary on the map representing the eastern end of the Perry County fault. The middle one of the three short anticlines there represented, is the small ridge thrown up by the third fault, and is therefore monoclinal, with south-east dip, and not anticlinal in structure.

PROC. AMER. PHILOS. SOC. XXI. 114. 2C. PRINTED NOVEMBER 2, 1883.

Note on a relic of the Native Flora of Pennsylvania, surviving in Perry County. By E. W. Claypole.

(*Read before the American Philosophical Society, May 18, 1883.*)

One of the inevitable, but, to the biologist, deplorable consequences of the spread of cultivation, is the extinction of many of the native or wild species of plants and animals. Could we have complete catalogues of the original flora and fauna of any country where nature has been long and entirely subjected to man, we should find many a name which would to us represent no existing being. It would be the name of a member of the aboriginal races which had proved unable, essentially or accidentally, to maintain its ground in the changed circumstances against its former companions, and had consequently died in the struggle. Or it might be, in the case of America, the name of one that, though able to hold its own against all its native competitors, failed in the contest with some of the new species introduced from more highly developed Europe, where for centuries the struggle has been more intense than here. In either case the result has been the same to the species—ultimate extinction.

It is a notorious fact in geology and botany, that many animal and vegetable species from the Old World have crossed the Atlantic in the traces of the white man, either as his friends or his foes, and have squatted on the lands of America, and made themselves as completely at home here as in Europe, some of them much more so. Without entering into the subject at any length, it may suffice to mention among the former, the house fly, the honey bee, the brown rat, the cabbage butterfly, the English sparrow, the currant and apple worm, the wheat midge, and, though some have disputed this, the Hessian fly. Among the latter may be named the white weed, the purslane, the carrot, the parsnip, the chicory, mullein, toadflax, catnip, &c., &c. All these have proved themselves fully competent to hold their own against the native races of America, and even to conquer them by one means or another in the struggle for existence.

Cultivation, however, is a more deadly foe than competition to many of our native species. The axe and the plough change the conditions of life so suddenly and so greatly that many a plant and animal are deprived at once of both food and shelter. Confining our attention now to the former, the plants, we may notice two or three principal causes of the destruction of some of our aboriginal species.

1. The loss of shade resulting from the destruction of timber. The plants of our woodlands and forests cannot all endure the brilliant, blazing sun that pours down upon them when the trees are felled. The direct heat seems fatal to many. The resulting drought destroys more. The moisture-loving ferns, without exception, dislike the sunshine, and though some of them, such as the common polypody, do not require much water, yet they shrivel and die when deprived of shade. It is not too

much to say that were it not for cool, moist glens and caves, where plough and ploughman can never come, many of these beautiful plants, the loveliest ornaments of the herbarium and the garden would have long since disappeared from the land. As it is, many of them, both here and in Europe, are almost extinct. They linger on, their lives hanging by a thread, which accident, or the hand of a ruthless collector, or of an over-eager botanist, may at any time snap asunder. Such are the elegant Killarney fern in Ireland, and the Trowbridge fern in England, and such may before long be the condition of the Hartstongue and the Climbing fern in this country.

2. The competition of native races, and of introduced species under the new conditions, is another element in the problem. Enough, however, has been said above on this point.

3. The cultivation of the ground is a most potent factor in the destruction of many native species. Few, except annual plants, can long survive this incessant disturbance of their roots. Of these consist, for the most part, our weeds. But the perennial species, especially those which require several years to produce seed, and then produce it sparingly; those that are choice of soil and conditions, cannot maintain themselves under cultivation, and soon fail and die.

There are certain species, I may say certain groups, which are less tolerant of man and the conditions which he introduces than others. The gap between them and civilization seems wider than it is in other cases. They are the real "wild" flowers which cannot be tamed, and usually die if the attempt to tame them is made. Like the wild Indian tribes of this continent, who are so far removed from the white man and his ways that their civilization seems scarcely possible, these "wild" denizens of our "wild land" refuse to acknowledge man's supremacy, and die if he tries to assert it.

Among these truly wild flowers are many of the HEATH FAMILY; specially attached to the moor and the forest. Their very name is synonymous with wildness and freedom. The heather of Scotland brings up vividly the breezy moor and brae and fell. It is an emblem of the "land of brown heath and shaggy wood." But the Scotch heather, like many of its relations, refuses to be confined within the garden fence. It is difficult to transplant and difficult to nurse even if successfully transplanted. It seems as a mountaineer imprisoned in a dungeon, impatient of its confinement, and rather than live in such conditions, refuses to live at all. The Mayflower, gem of the spring in North America, manifests similar impatience of confinement, and the same is true of several other members of the family.

In Perry county there lingers one of these survivors of our native flora doing battle for its existence against conditions in which no member of its family can long survive. It is struggling against the inroads of cultivation on its native haunts, and struggling against heavy odds.

In the "Flora of North America," Michaux described *Vaccinium brachy-*

cerum or *pumilum*, the box-leaved huckleberry, a low evergreen plant of the Heath Family, giving as its habitat "near Winchester." Its discovery was a testimony to the thoroughness and minuteness of his work in a day when traveling for botanical investigation in North America meant hardship, privation and even danger. The county was unsettled and uninhabited, and the botanist was compelled to wander over pathless mountains, and through forests where the lumberman's axe had never been heard, and to carry with him the results of his labors on his shoulders, or at best on horseback. Yet in some cases he and his fellow-workers lighted on plants to find which again has required long and painstaking search or lucky accident.

Michaux's description and specimen remained for many years the only evidence of the existence of the Box Huckleberry in the world.

About the year 1846, Prof. S. F. Baird, now Secretary of the Smithsonian Institution, was engaged in teaching at Carlisle, Cumberland Co., Pa., when he was informed by a friend living in New Bloomfield (Thomas McIntyre, Esq., recently deceased) that a plant called in the neighborhood "Boxwood," was growing wild near that town. He paid a visit to the place under Mr. McIntyre's guidance, and obtained specimens of the plant both for the herbarium and for cultivation. The latter he sent to the Botanical Garden at Cambridge. This was Michaux's plant, *Vaccinium brachycerum*. Its existence in Pennsylvania had been previously unsuspected, and it was thought to be a lost species. Prof. Gray kindly informs me that those specimens planted in the Garden nearly forty years ago, are still living, and that the plants bloom, but never produce any fruit. Evidently the climate of New England does not suit the species, or it resents the attempt at domestication.

Its Habitat in Perry County.

Vaccinium brachycerum, Michaux, *Gaylussacia brachycera*, Gray, now occupies in Perry county a spot of about ten acres, one mile south of New Bloomfield, the county-seat. This tract lies on a hillside sloping principally to the north-west, and occupied by small timber and laurel. Cultivation has encroached upon it, and so far as I can determine its range was somewhat greater only a few years ago. This is, however, not certain, as Professor Baird does not very clearly recollect how far it spread in 1846. One of the most remarkable facts connected with it is the very sharp line which marks its limit. The wood in which it occurs extends for some distance along the road, but the Box Huckleberry only grows as far as a hollow occupied, in wet weather, by a small stream. Along the right bank of this stream it is found freely, on the left side I have never seen a plant. Hence it is quite possible that the plant has been restricted in its range for a longer time, and that it did not previously occupy the rest of the wood. This is rendered more probable by the fact that in other directions its range is equally restricted, and its limits as sharply defined. It is per-

fectly easy to walk round the space on which it grows, and see a thick mat of it on one side and not a plant on the other. No difference, so far as I can discover, exists to account for this limitation. The soil and subsoil are alike on both sides. Both are timbered, and with the same kind of trees. Slope, exposure, sunshine and drainage are the same. Yet the limitation exists, and is most emphatic.

The most probable conclusion is that we have here a plant to which the conditions of life are becoming or have become unfavorable, and which is very gradually yielding to their ill effects. These have, perhaps, been at work for ages in restricting its range, and would in time have destroyed it. Cultivation, however, is its most formidable foe—a foe which may, in a single season, inflict more injury than natural enemies could accomplish in centuries. Two seasons of ploughing would blot the species out of the county, and, saving the garden specimens at Cambridge, probably out of the world; for Professor Gray informs me that it can not now be found at the locality given by Michaux in his description, "near Winchester," or at that given on his specimen, "Warm Spring," and, with the exception of one small habitat in Delaware, no other place is known in which it has ever been seen.* One or two other supposed habitats, which have been mentioned to me turned out on examination to be erroneous or doubtful.

In its native dwelling place in Perry county, it is now (May, 1883) in abundant blossom, but judging from the appearance of the fruit of last

* With regard to this habitat for the Box Huckleberry I had not been able to obtain any definite information at the time of writing the above paper. Since then, however, I have been favored by A. Commons, Esq., of Faulkland, New Castle Co., Delaware, with a few particulars concerning it. I give an extract from Mr. Commons's letter:

"The Box-leaved Huckleberry was found by me some years ago growing on the banks of the Indian River, near Millsborough, in Sussex Co., Delaware. I have collected it there at various times but none very recently. Another locality was reported to me when at Millsborough, said to be about a mile from the town in an opposite direction, but I did not visit it. I am not aware of its occurrence elsewhere in this State, and the patch here is not large. The locality is at the head of tidewater on this river. It extends along the steep bank which is here 10 or 12 feet in height from a few feet above the water-line to the top of the bank, but not beyond this. My impression is that it may have been introduced by tidal agency."

A hill-side in Perry Co. and the bank of a tidal river in Delaware, are places affording very different conditions, but Mr. Commons has kindly sent me specimens between which and those from this county I cannot discover the slightest difference.

I may further add that while gathering some of the plants I one day found a small caterpillar feeding on the leaves and spinning them together to form a nest. I put it into a box and it almost immediately went into a chrysalid and in about a month emerged a small Tineid moth with black forewings speckled with white. I sent it to V. T. Chambers, Esq., of Covington, Ky., who has made a special study of this family, and he informs me that it belongs, almost with certainty, to a species described by himself as *Gelechia dubitella*, Chamb., and which has been reported to feed on the Hogweed or Bitterweed, *Ambrosia artemisiifolia*.

year, it does not produce seed very freely. If this is true, one potent cause of its diminution and decay is obvious.

Like some other plants apparently also verging towards extinction, such as the Big Trees of California, this little survivor of the old flora of Pennsylvania shows no disposition to spread in Perry county, even in directions where it is unmolested. Ground lost by such a species cannot well be recovered. Point after point has been ceded to its foes; it has been killed off here and headed back there till now it lingers on this hillside, its last stronghold in the State, and almost in the world. What special causes have enabled it thus and there to maintain its ground against its foes it is impossible to say, but its position is very precarious. A little more cultivation, a little more ploughing and harrowing, a little more "clearing up" and "burning of brush," by the farmer, unaware of the value of what he was destroying, and the little Box Huckleberry will be numbered with the things that were and are not. Its only chance lies in the steepness and sterility of the hillside, which all botanists must hope will enable it long to maintain the unequal contest against so many dangerous foes. Perry county and Centre township will then continue to boast the possession of a natural botanical garden, containing one of the most interesting vegetable relics on earth.

Appendix.

August, 1883. The fruit of the Box Huckleberry is now ripe, and compared with that of other species is scanty. The berries grow singly and not one plant in ten is productive. They are edible, but lack sweetness, and are hence perhaps less attractive to animals. The blossom in early May was profuse, more so than that of its kindred species. The fruit is of the same size as theirs and is covered with a bloom like that of the low blueberry.

On the Equivalent of the New York Portage, in Perry County, Middle Pennsylvania.

(Read before the American Philosophical Society, September 21, 1883.)

The Cardiola Shale.

About 200 feet above the Fenestella shale, the topmost bed of the 300 feet of Hamilton Upper shale, which in Perry county is the highest layer in which a Hamilton fauna occurs, is a mass of shale differing in some respects from that above and below it. Though no sharp plane of limitation can be drawn at its base to separate it from the 200 (?) feet of barren black slate which is here the representative of the New York Genesee shale (so far as hitherto determined), yet a good physical distinction between the two is afforded in the field by the bleaching of the latter under the action of the air and light. This is so complete that a bank of weath-

ered material from these (Genesee) beds is quite white, whereas a fresh broken mass is nearly black. The shales of which I am now writing do not manifest any so marked change of color, but retain much more firmly their original black tint. They are very smooth and free from sand, usually dark, but sometimes greenish. They may be distinguished somewhat roughly in the field from the overlying Chemung proper, by the former of these characters and especially by the absence of those even-bedded, thin, fine-grained, square-fracturing beds of sandstone which so distinctively mark the Chemung proper in this region.

The beds below these Cardiola shales, that is the representatives of the Genesee of New York, are remarkably barren, and have thus far yielded me no fossils in Perry county. The lower beds of the Chemung proper have also proved unprofitable ground. But the 200 feet of shale to which I have assigned the above name, though by no means rich in fossils, have nevertheless yielded a few species which enable me with confidence to assign them their place as representatives of the Portage group of New York. Some of these are peculiar to these beds, and must therefore be considered "characteristic" for the district. Chief among them, and almost everywhere present where these beds are exposed, is the small but beautiful lamellibranch figured in the Geology of the Fourth District of New York, by Prof. Hall, under the name of *Avicula speciosa*, now *Cardiola speciosa*. This shell was confined in its range to the Portage group of New York at the time of publication of the Geology of the Fourth District, but is reported in the later volume (vol. v. p. 1) to occur also in the Genesee. In Perry county this species occurs toward the top of the beds that lie between the summit of the Hamilton and the base of the Chemung proper, and there is consequently little precipitancy in referring them to the Portage, a conclusion which is in full accord with the evidence furnished by stratigraphy.

I have not yet succeeded in establishing any wide or general physical plane of demarkation at which the fossils given on the next page cease and the Chemung fauna proper begins. The beds are somewhat barren with the exceptions here noted. But a very convenient local horizon is afforded by a heavy bed of sandstone which occurs about 200 feet above the top of the equivalent of the Genesee slate.

This bed of sandstone does not crop out in many places, but I have found it on the north side of the Buffalo hills on the road running from the old Juniata Furnace, where it forms the bank of the stream, and is thicker and more solid than anywhere else. It is also exposed on the road from Bloomfield to Newport, about a mile from the latter town.

Adopting this view we have, for Perry county, the following section in this part of the column :

	Feet.
Chemung shale and sandstone	
Portage-Chemung sandstone.....	20
Cardiola (Portage) shale.....	200

	Feet.
Genesee shale	200
Fenestella shale	15
Tropidoleptus shale	15
Hamilton Upper (Ochrey) shale	150
Hamilton Fossil ore and Paracyclas shale	5
Hamilton sandstone	

THE CARDIOLA SHALE AND PORTAGE BEDS OF PERRY COUNTY.

List of Fossils.

1. Cardiola speciosa, Hall.
2. Styliola fissurella, Hall
3. Lunulicardium fragile, Hall.
4. Ambocœlia fimbriata, n. s.
5. Strophodonta perplana, v. parva, n. v.
6. Goniatites complanatus ?, Hall.
7. Coleolus acicula, Hall.
8. Poteriocrinus, sp. ?
9. Aulopora tubiformis, Hall.
10. Streptelasma, sp. ?
11. Pleurotomaria ?

Details on the palæontology and descriptions of the new species are deferred for want of time.

The new species *Ambocœlia fimbriata* named in the preceding list very much resembles the kindred species from the Hamilton, *Ambocœlia umbonata* Hall, but differs from it chiefly in being set with small, fine spines in regular concentric rows, a feature of which I have seen no trace in the fossils of this genus from other horizons in the county. The presence of these spines gives the casts of *A. fimbriata* an appearance much like those of *Spirifera fimbriata*, Hall.

Wherever the two beds can be examined in position I have found that those containing *Ambocœlia* lie above those containing *Cardiola*. In most sections only one of these fossils can be obtained, the exposures being usually small. Both are, however, so far as I have observed, strictly limited to this horizon, and consequently either is available for determining it.

The best exposure of the Cardiola shale in Centre township is about two miles S. W. of New Bloomfield opposite the house of Mr. Samuel Brown, and for some distance thence toward the hill (Iron ridge) where a small cut shows the shales containing *Cardiola speciosa* and *Ambocœlia fimbriata* in abundance. Measurement of their thickness is difficult on account of the concealment of their base and the uncertainty of dip which is not uniform in either degree or direction. Considerably more than 100 feet is exposed, and towards the upper part of the section the typical Chemung sandstones begin to appear among the shales. The Genesee slate is entirely con-

cealed, unless its topmost layers yield the loose material shown in the roadside cut nearly opposite Mr. Brown's house. This part of the section has yielded no fossils.

The Cardiola shale also appears in the side of the road leading to Perry Furnace near the house of Mr. Quigley. It is here a very smooth, yellow green shale, and has yielded

Cardiola speciosa.
Strophodonta perplana v. parva.
Ambocœlia fimbriata.
Styliola fissurella.
Goniatites complanatus?

A third exposure of these beds is at the mouth of Losh's run, in Wheatfield township, where, in a cut on the roadside, the lower or Cardiola beds may be seen and their fossils collected. I have obtained here,

Cardiola speciosa.
Strophodonta perplana v. parva.

A fourth exposure of these Portage beds is on the south branch of Losh's run, about two miles west of the Juniata and near the cross-roads, at the house of Mr. D. Bosdorf. Here the upper beds only occur, yielding

Ambocœlia fimbriata.
Strophodonta perplana v. parva.

A fifth exposure of these shales is on the road leading south from Newport to the ore works on Limestone ridge, near Pine grove. Near the house of Mr. J. Ramer occur dark smooth shales by the road yielding

Styliola fissurella.
Cardiola speciosa.
Coleolus acicula.

A sixth exposure of the same shales occurs near Newport, on the upper road to Baileysburg, soon after leaving the river. Here the Portage-Chemung sandstone is cut twice at a bend in the road, and close underneath it come the shales yielding the usual fossils. Only a few feet of the highest part of the Portage are exposed, but the following species were found after a short search:

Cardiola speciosa.
Ambocœlia fimbriata.
Styliola fissurella.
Aulopora tubiformis.
Strophodonta perplana v. parva.

This exposure has also yielded me a small crinoid *Poteriocrinus*, apparently undescribed, and a *Streptelasma*, both of which I have been unable for want of time to examine minutely.

I have little doubt that the fauna of this Portage group might be much increased by longer search. One or two additional species have been already obtained by recent visits to some of the other places mentioned above.

The following extract from the Geology of the Fourth District of New York will show the close resemblance between the rocks at the two places: "The thick-bedded sandstones at Portage form the terminal rocks of the group." "The upper part consists of thick-bedded sandstone." "The arenaceous strata of the Portage group are always more argillaceous than those of the Chemung group."

It appears from Prof. Hall's description of the group that it begins with beds very free from sand—the Cashaqua shale—and ends with a heavy thick-bedded sandstone. At least this is its character at its eastward exposures on the Genesee river. Farther west the sand, as usual, disappears and the group contains little except shale.

The Portage group in Perry county comes, therefore, as near to the typical Portage group in New York, as can be expected—near enough in stratigraphical and palæontological characters to give full confidence in their identification.

I may add, in conclusion, that some of the shale beds near the Portage-Chemung sandstone are much valued locally as whetstones. These apparently occur both above and below the sandstone.

In one place also, a bed of light-colored brown hematite has been exposed lying on the top of the sandstone and about eighteen inches thick. This is the only case of the occurrence of a bed of iron ore of any appreciable thickness in the Chemung of Perry county. No trial has yet been made of it, but judging from appearance it would not be of high grade.

The facts given above are useful in that they enable us to separate 400 feet from the great mass of olive shale in Perry county. The separation of 200 feet, as the Hamilton Upper shale, was mentioned in the beginning of this article. The total thickness of the olive shales of VIII has been given in the neighborhood of Newport, at about 5500 feet, thus divided:

Chemung	3800	
Portage	600	about.
Genesee	1120	
	5520	

But these measurements are much exaggerated. They have apparently been made along the Juniata, without noticing a fold which occurs at Inoculate run, and the effect of which extends beyond the river. The ground is very difficult, but the following figures, which I have obtained with considerable trouble and checked as carefully as was possible with the limited time at my command, are certainly nearer the truth for the neighborhood of Newport:

Chemung	3000
Portage	200
Genesee	200
	3400

It thus appears that after the separation of the 600 feet above mentioned,

the thickness of which is only approximately given here, there yet remains an immense mass, the subdivision of which is more difficult, but would not perhaps be impossible if sufficient time were allowed.

I am unable as yet to say if these Cardiola shales extend far north and south, no exposures having been yet found. But the places above mentioned trace them through the middle of the county from south-west to north-east, a distance of seven or eight miles. Their farther extension is very little less than certain.

Appendix.

Since the above paper was read I have spent a few hours with Prof. I. C. White, now engaged in the survey of Huntingdon county. With his assistance I found the bed here described and most of its fossils near Huntingdon. The thickness, though shortness of time prevented measurement, seems also very nearly the same.

Note on the Genus Rensselaeria in the Hamilton Group in Perry Co. By *E. W. Claypole.*

(*Read before the American Philosophical Society, September 21, 1883.*)

The Genus Rensselaeria, Hall, was established to receive certain Brachiopods, some of which were new, and others of which had previously been known under other names. They were distinguished by their general outward form and certain peculiarities of internal structure from other Brachiopods nearly allied to them.

The Genus Rensselaeria is limited in Eastern North America to the Lower Helderberg and Oriskany groups, four of its twelve species occurring in the former and seven in the latter. One only, a small species, *R. Johanni*, Hall, has been described from the Upper Helderberg of Waterloo, Iowa. Of this Prof. Hall speaks doubtfully, referring it to this genus only on account of its external characters.

Prof. Hall informs me that he has since that time removed this species from the genus. It is, therefore, rather surprising to find well-marked specimens of Rensselaeria high up in the Hamilton group of Middle Pennsylvania. Yet the sandstone, so conspicuous a feature of this group in Perry and adjoining counties, yields, near its middle, a bed which is in some places little more than a mass of shells of a form which can scarcely, if at all, be distinguished from *R. Marylandica* of the Oriskany sandstone.

In some places this shell is found almost alone, but in others it occurs mixed with *Spirifera formosa*, or a species so like it that I cannot distinguish them. This Spirifera is the most abundant fossil in the Hamilton sandstone of the county, occurring sometimes in myriads.

The Hamilton sandstone is a peculiar deposit of sand in the midst of a vast accumulation of shales. It covers a district extending from the Blue mountain northward for about fifty miles and eastward to the neighborhood of the Schuylkill river. Westward its limit cannot be traced, as it is destroyed by erosion, but from appearances it was as great as in the east. It lies between a mass of shale above and another mass below, and at its greatest development is about 800 feet thick, at the Susquehanna gap. Some of its beds, especially toward the middle, are very hard and flinty, but it grows more and more shaly as it recedes from this point. Apparently it exists at some distance from its point of greatest development as a sandstone mass below and another above, with intervening shales.

Note on a large Crustacean from the Catskill Group of Pennsylvania. By E. W. Claypole.

(*Read before the American Philosophical Society, Sept. 21, 1883.*)

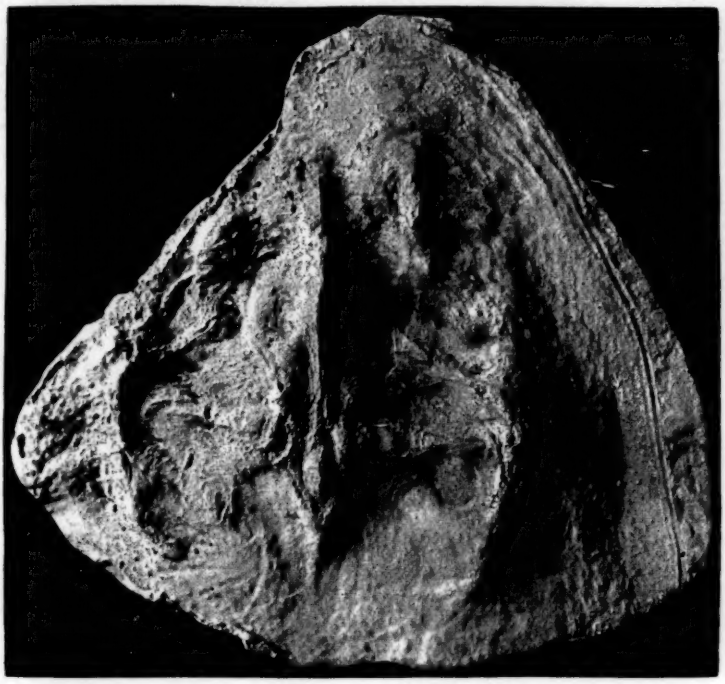
I have lately received from Mr. R. D. Lacoe, of Pittston, a slab of green sandstone, from the Catskill group of Wyoming county, containing a well-preserved head of some creature. Though not complete, yet enough remains to enable me to form a good idea of what the full form of the head must have been.

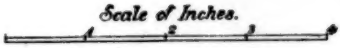
It measures eight and a half inches across the broadest part, and the same from front to back. The outline is semi-elliptical, the part preserved corresponding to a piece cut from one of the ends of an ellipse. It is somewhat distorted, and may when perfect have been more nearly semicircular. The outline is slightly wavy, but this also may be due to distortion. Fortunately the right side is almost perfect and, being symmetrical, it is not difficult to reconstruct the other. A good idea of its general shape may be suggested to a palæontologist by saying that it resembles the head of *Cephalaspis*.

A longitudinal median ridge runs from near the front margin almost to the back of the portion preserved, dividing the head surface into two equal parts. This ridge rose near its front end into a low tubercle, or perhaps a spine, and near its hinder end into a distinct and boldly elevated spine which is, however, crushed down almost flat. Posteriorly the ridge narrows and tapers down to the general surface.

At the place of the posterior spine another ridge, less distinct, crosses the former at right-angles, and itself rises at its two ends, midway to the outer margin, into low prominences from which two semicircular ridges, convex outwardly, run curving in toward the median line at both their ends, one in front, the other behind the cross-ridge from which they start. Each cross-ridge, with its semicircular branch, resembles in outline an

Proceedings of the Amer. Philos. Soc. Phila. Sept. 21, 1883. Vol. XXI. Page 236.





DOLICHOCEPHALA LACOANA, Claypole, from the Catskill rocks of Wyoming county, Pennsylvania.

anchor-shank with its two arms. Right and left of the anterior tubercle, and not quite half way between them and the margin, arise two broad, rounded prominences anteriorly, elongated and connected with the median ridge by a scarcely perceptible elevated tract.

The whole surface of the head is covered with small wrinkles or tubercles, the former chiefly in front, the latter behind, and the margin is marked by a narrow groove about one-eighth of an inch in breadth, resembling that which often marks the head of a trilobite.

No trace of bone can be found upon the specimen, so that there is no ground for supposing that it is the head of a fish. But the greater part of the surface is covered with a thin, black, perhaps carbonaceous, coating, highly suggestive of the carapace of a crustacean. This is, beyond doubt, its nature, and the fossil represents a large species hitherto unknown, and from an horizon which has thus far yielded nothing similar to it. The only crustaceans yet announced from the Catskill are some small entomostracans mentioned by the writer at the meeting of the American Association at Montreal. The specimen in question possesses therefore an unusual interest.

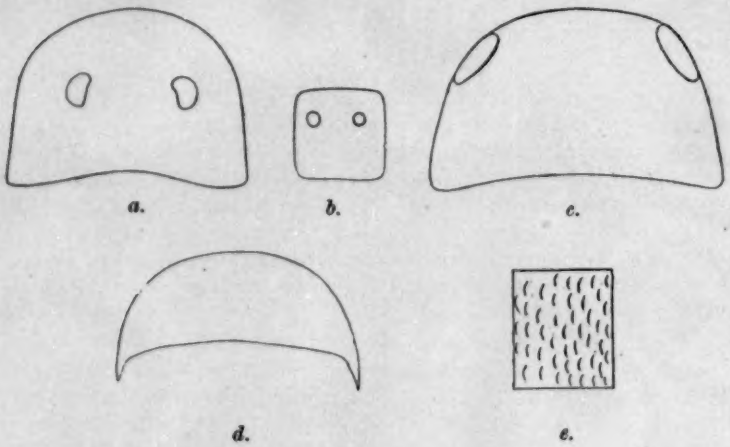
From so small a portion of the specimen it is difficult to assign it its exact place in the animal scale, but among the crustaceans we are led immediately to look at the allies of the existing king-crab, *Limulus*, and those of the fossil *Eurypterus* and *Pterygotus*. Both of these possess the peculiar trilobitic head-shield, and may, therefore, supply useful information concerning this species.

But the general outline of the fossil being semi-elliptical, does not well agree with that of *Limulus*, and its fossil allies, which is semicircular. Limuloid forms descend to us from Silurian days, but they all present a semicircular head-shield similar to that of the living king-crab, *Limulus Polyphemus*, or *Moluccanus*, of the east coast of America, and the Molucca islands. The same form of head-shield characterizes all the fossil genera allied to *Limulus* — *Hemiaspis*, *Bunodes*, *Euproops*, *Belinurus*, and *Halycine*. It is, consequently, impossible to refer our specimen to the dagger-tailed family of *Xyphosurans*.

Not better does the outline of the head agree with that of the rounded, oblong head-shield of Pterygotus and Eurypterus. Yet, in some respects, it reminds us of these. But the discrepancy is too great to allow of its reference to any established genus of the Eurypterids. This will be evident on an examination of the accompanying outlines.

The eyes being undiscoverable in the fossil, the important evidence which they might afford towards settling its relationship is not available, but very important and conclusive testimony is derived from the markings on the surface of the carapace. Beside the wrinkles or tubercles mentioned above, the crest is covered with small, delicate, crescentiform sculpture, resembling that which is characteristic of the Eurypterids, and a representation of which is given in the plate.

Considering all these facts I have determined to place the fossil in a new genus established to receive it, and named from the elongated head *Dolichocephala*. The generic and specific descriptions are necessarily imperfect, being founded on imperfect specimens, but the characters of the head are distinct.



a. Eurypterus remipes,
b. Stylonurus Logani.
c. Pterygotus Anglicus.
d. Limulus rotundatus.
e. Scale-like sculpture of *Dolichocephala*, nat. size.

DOLICHOCEPHALA, n. g.

Genus of Crustaceans allied to Eurypterus. Head-shield only known. General outline semi-elliptical (the length being parallel to the major axis of the ellipse). Surface slightly convex; margin furrowed. Medial line marked with an elevated ridge, beginning near the front, and rising into spines or tubercles at different points along its course, sinking again to the general level posteriorly. Another obscure and interrupted ridge or row of tubercles lies between the median ridge and the margin, and another, more or less defined, crosses the median ridge at right angles near its hinder extremity.

Whole surface marked with small, low tubercles, and, beside these, with minute delicate scale-like sculpture.

DOLICHOCEPHALA LACOANA, n. s.

General outline as in genus; margin with two narrow furrows and a fillet between them, the whole almost a half an inch wide. Median ridge

well marked, rising anteriorly in a low spine or tubercle, and again in a larger or more prominent one at its hinder end. A lower ridge crosses this at right angles, extending about half-way to the margin, and at the end of this are two semicircular ridges curving inward half-way to the median ridge, and sinking to the general level. In the hinder angle, between this and the cross ridge, is a roundish mark which may indicate the place of the eye. Another elongated tubercle or short ridge lies between the anterior end of the median line and the margin.

Surface marked with crowded, low tubercles, and with the delicate, scale-like sculpture of the genus.

The fossil was found in the sandstone of the Catskill group at Meshoppen, Penna., and is the property of R. D. Lacoe, Esq., of Pittston, to whose kindness I am indebted for the use of the specimen, and in whose honor I have named it.

There is a species of Eurypterus described by Prof. Whitfield, in the forthcoming volume of the Palæontology of Ohio (New fossils from Ohio. Pamphlet), of which he says:

"The cephalic shield is proportionately broader than that of *E. remipes* or *E. lacustris*, and is more regularly rounded or arched on the anterior border, lacking that subquadrate form characteristic of those species."

This species, *Eurypterus Eriensis*, from the hydraulic limestone of Put-in-Bay, Ohio, shows a manifest departure from the ordinary type of the head of Eurypterus, but the variation seems rather in the direction of *Limulus* or *Euproops*, than in that of *Dolicocephala*. As Prof. W. does not mention the size of his specimen, it is impossible to say how nearly the two approach in that respect. The horizon from which it comes in Ohio is the equivalent of the waterlime of New York, to which the genus Eurypterus is almost entirely confined. Two species are described from the Coal Measures, and one from the Devonian, of Pennsylvania.

Stated Meeting, October 5, 1883.

Present, 10 members.

A photograph of Professor James Morgan Hart was presented for insertion in the Album.

Letters of acknowledgment were received from the Smithsonian Institution (113), and the Sociedad Economica de Valencia, September 16.

A letter of envoy from the Department of the Interior was read.

Donations for the Library were reported from the Annales des Mines, Revue Politique, Commercial Geographical Society at Bordeaux, Meteorological Committee and London Nature, Essex Institute, Boston Natural History Society, American Journal of Science, New Jersey Historical Society, Franklin Institute, American Medical Association, Journal of Pharmacy, H. Phillips, Jr., United States Fish Commission, Surgeon-General's Office and United States Geological Survey.

An obituary notice of the late Henry Seybert was read by Mr. Moncure Robinson.

The death of Prof. J. Reinhard Blum at Heidelberg, August 22, aged 80, was reported.

The death of Prof. W. A. Norton at New Haven, Connecticut, September 21, aged 72, was reported.

"The Zone of Asteroids and the Ring of Saturn," by Prof. Daniel Kirkwood, of Bloomington, Indiana, was read by the Secretary.

Prof. Barker brought to the attention of the Society a number of electrical novelties: small batteries which can be sealed up and applied to special practical purposes, such as lighting gas lamps, treating nervously diseased patients, ringing an alarm bell when the heat of a room becomes unduly raised, &c., and a new and much cheaper method of coiling and insulating wire, by winding the naked wire and a cotton thread together on the same spool. These inventions of Mr. Clarke of Manchester, were exhibited and explained.

Pending nominations Nos. 985 to 1006 were read.
And the meeting was adjourned.

OBITUARY NOTICE OF HENRY SEYBERT.

By Moncure Robinson.

(*Read before the American Philosophical Society, October 5, 1883.*)

Mr. President and Gentlemen:

I have occasionally, when asked to write an obituary notice of a departed friend, felt, as a prominent citizen in the earlier days of our Republic is said to have replied, when asked if he would accept a nomination to the Presidency, "The office" (his reply was) "is one not to be sought or declined." The eminent and virtuous citizen who, sixty years ago, made this reply, made it in view of the immense responsibility of the office. But, Mr. President, more or less responsibility attaches to the performance of all the duties of life, and the writer of a brief sketch of the life of a departed fellow-citizen, for the information of the public, is obliged to recollect the motto "*de mortuis nil nisi verum*," as well as that "*de mortuis nil nisi bonum*." None of us, sir, are infallible, or free from the frailties which pertain to our humanity, and we should act tenderly and affectionately, as well as truly, in dealing with either frailties or mistakes, especially when, as in the case of our departed friend, they were only *peculiarities* not amounting to a fracture, or a flaw, or even a blemish, in the escutcheon of a life of blended usefulness and goodness.

The friend, Mr. Seybert, of whom you have re-

PROC. AMER. PHILOS. SOC. XXI. 114. 2E. PRINTED NOVEMBER 7, 1883.

quested me to write an obituary notice, was at the time of his death the oldest member of our Society; one who at an earlier period in the annals of societies would have borne the title of *its Dean.* He was elected one of its members January the 16th, 1824, three weeks only after the twenty-second anniversary of his birth, at a period when the Society had on its list of members as many distinguished and learned men as at any period before, or since, when (as I presume is still the case), new members were nominated and elected without the slightest previous knowledge of their nomination being proposed, and when in the case of rejected nominations, no one besides those present knew that their names had been presented for consideration. On the 5th of March, 1824, between six or seven weeks after his election, Mr. Seybert read to the Society a clearly written and most interesting analysis of the chrysoberyls of Haddam (Connecticut), and Brazil, a mineral and gem next to the sapphire in hardness, and which had for some years previous attracted much attention on account of its rareness, rather than its value. This inaugural discourse of Mr. Seybert will be found in Volume 2d, Article No. 3, of the new series of transactions of the Society, page 117.

It is proper before proceeding farther, to tell you something of the parentage and early training of Mr. Seybert, which will explain how he became a member of our association at an earlier age than any member

who preceded or succeeded him, since its foundation to this day.

His father, Adam Seybert, was a Philadelphian by birth and education, and distinguished as a chemist and mineralogist, who represented his native city in Congress during eight successive years, three of them (the years 1812, '13 and '14), years of great trial, and at the time characterized as the period of our country's second war of independence. Between the close of this war and 1818 Mr. Seybert found time to prepare and give to the world, whilst performing faithfully his duties as a member of Congress, and in his laboratory, his "*Statistical Annals of the United States of America*," a work reviewed in the Edinburgh Review of January, 1820, by the Rev. Sydney Smith, in an article which speaks of it as "a book of character and authority," "which will form a pretty complete portrait of America, and teach us here to appreciate the country, either as a powerful enemy or a profitable friend."

As a chemist and mineralogist he is spoken of in a work by Professor Benjamin Silliman, of Yale College, entitled "American Contributions to Chemistry," page 36, as follows:

"Adam Seybert is one of the few American chemists who enjoyed the advantages, rare at that time, of a training in the School of Mines at Paris, late in the last century. He has left few papers, but his memoir, read before the American Philosophical Society, March 10, 1797, entitled, 'Experiments and Observations on

Land and Sea Air,' is of interest, as the earliest example of such a research on our records. It relates the results of twenty-seven analyses of air made by the author at sea, in a voyage across the Atlantic, and also the comparison of these results with other analyses made by him on land, near Philadelphia, by which comparison he reaches the conclusion that the air over the sea is purer than that over the land; that, while the latter varies with locality, the former is nearly constant; and he then ventures the suggestion that 'perhaps the impurities are absorbed by the agitation of the waves,' a conclusion to which modern investigation, by the use of more exact methods, has also arrived. Considering the imperfect condition of eudiometric methods in Seybert's time, his research and conclusions therefrom are decidedly creditable to his skill and sagacity."

The mother of Henry Seybert was Maria Sarah, daughter of Henry Pepper, Esq., of Philadelphia, one of its wealthy and respected citizens. Mrs. Seybert died during the early infancy of her son, and the care of him in infancy, and responsibility of his whole educational training, thereby devolved exclusively on his father, who remained a widower until his death, in Paris, on the 2d of May, 1825.

I met there a few days after the death of his father, Mr. Henry Seybert, who had accompanied him to Paris, and been there his constant companion and solace, during the critical disease which ended his

father's patriotic and useful life, at the comparatively early age of fifty-two years. He was in deep mourning, and, being naturally reserved, had but few acquaintances among his countrymen in Paris, themselves then comparatively few in number. Being within a few weeks of the same age with him, and sincerely sympathizing with him in his profound sorrow, we became, naturally, in a short time well acquainted. This acquaintance ripened, during our travels together in England the following summer, into a respect and friendship which continued uninterrupted, until we were separated by his death on the 3d of March last.

At that time, and indeed until recently, I knew but little of the honorable and valuable life which Mr. Henry Seybert had been leading for several years previous in his native city. His disposition was taciturn, and he preferred generally listening to the opinions and conversation of others to taking part in conversation himself, and but for the request of the Society to prepare this tribute to his memory, I should probably never have known how highly he was estimated at the time of our first meeting, by eminent chemists and mineralogists, of both Europe and America. Professor Benjamin Silliman, in the volume before quoted from, in which he speaks of Mr. Adam Seybert, makes the following mention in page 74, of the same, of the son:

"Like his father, Adam Seybert, he was educated in the School of Mines in Paris, and was an early contributor to our knowledge of the constitution of Ameri-

can minerals. In 1882 he analyzed the sulphuret of molybdenum from Chester, Pa.; chromate of iron from Maryland and Pennsylvania; the tabular spar pyroxene, and colophonite, of Willsborough, N. Y., and the Maclurite (chondrodite) of New Jersey (in which he independently discovered fluorine as Dr. Lanstaff had done before). He also analyzed the manganesian garnet, found with the cheisoberyl at Haddam, Conn., and the chrysoberyl of the same locality. In 1830 he analyzed the Tennessee meteorite of Bowen, since which date I have been unable to find any further contributions from Mr. Seybert, whose attention was unfortunately diverted from science, to which his early life was so advantageously devoted, to other and less fruitful lines of investigation."

It is to be regretted that Professor Silliman knew but little of the occupations of Mr. Seybert after the death of his father in the spring of 1825. Being the only living descendant of his father and mother, he inherited a large fortune, and it is certainly not singular, that a young gentleman of twenty-three years of age, who had inherited a fortune estimated by his contemporaries at $300,000, who had been occupied closely for several years in the laboratory, in chemical and mineralogical investigations, which had made him an honored member of our body, and given him a name and reputation among the scientists of Europe, at the early age of twenty-two, but who had at that time seen nothing of the great world, should have

been tempted to give up for some years, to a great extent, the laboratory, for the pleasures of society and travel. To this, is no doubt ascribable the fact that after May, 1825, the period of his father's death, Professor Silliman was unable to find "any further contributions from Mr. Seybert," besides the analysis of the Tennessee meteorite of Bowen in 1830.

It has been suggested that the last sentence above quoted from the discourse of Professor Silliman, had reference to his spiritualistic investigations. If so, Professor Silliman labored under a great mistake as to Mr. Seybert's occupations between 1830 and 1850. During all that period he was certainly much more of *a Materialist than a Spiritualist*, but I think more of *a Christian*, though for a time a doubting one, than either. But notwithstanding his religious doubts, and perplexities, he gave, during that period, both in this country and Europe, where he passed much of it, his attention and aid to works of charity, and valuable enterprises. Among the latter I recollect his perfect confidence, speedily verified, notwithstanding the decided opinions and predictions of Lardner and others to the contrary, in the general adoption, within a brief period, of steamships between America and Europe.

It may indeed be doubted whether the large accession of fortune to Mr. Seybert, on the death of his father, was a fortunate feature in his history, and it very probably was not. Had it been less, he would probably have continued a co-laborer with his friends in

Europe and the United States, in his previous employments, and his reputation as a chemist and mineralogist, would probably have increased in a corresponding ratio with theirs. But it may fairly be inferred from what we now know of his traits of character, that he was one of those who believed in doing their duty in that state of life in which it pleases the Almighty to place them, and if so, he naturally inferred that duty in his own case, was materially modified by the possession of a large fortune, which, properly employed, might enable him to be more widely useful to his fellow-citizens and fellow-men, than he could be even if enrolled with the Elie de Beaumonts of Europe or the most distinguished chemists and mineralogists of America.

The change in the views of Mr. Seybert as to the life most proper for him in the future, was probably adopted soon after the death of his father, and a few weeks previous to his visit to England, in the summer of 1825, referred to in a previous page. We had the good fortune to have as traveling companions in this visit, that pure and excellent man and Christian gentleman, Mr. Nathaniel Chauncey, of Philadelphia, and Mr. Jaquelin Ambler, of Virginia, a member of one of the old and honored families of that State, in its better days.

We harmonized wonderfully in our views as to the places and objects to be visited by us; our scientist, Mr. Seybert, preferring, like the rest of us, a view of

the magnificent residences, and beautiful parks, and venerable Gothic temples of the past, with a brief stay in her manufacturing and commercial cities, to any other disposition of the time at our disposal. We found, in short, our companionship in England so agreeable, that we sought to continue it on our return to Paris by dining frequently together at the same restaurants, and table d'hotes, and passing our evenings at the same theatres, especially the Theatre Français, which, in the winter of 1825 and '26, still numbered Talma and Mars among its attractions. But there was one place in Paris especially attractive to *our partie carrée.* This was the residence of Madame de L., who had been unfortunate in her marriage, but was blessed with a lovely and beautiful little daughter, at the time only five or six years old, who was the pet of all of us. The husband of her mother, though well connected, was extravagant and wasteful in his habits, and had expended not only his own fortune, but a large part of that of his wife, thus creating the necessity of her receiving table boarders, and occupants of rooms, in order to secure the accustomed comforts to herself and daughter. Mr. de L. was occasionally, but not often, one of her guests.

Their daughter, who still retains a great deal of her own and her mother's grace and beauty, sent to myself, as well as Mr. Seybert, two or three years ago, an admirably executed photograph of herself, with a request, which I promptly complied with, that we would

send her ours. But my excellent though modest friend, Mr. Seybert, would not be persuaded that the wish expressed by her, was anything more than a compliment, and I do not think, at the time of his death, that he had sent his. I was truly gratified to find from his will, that though the compliment paid us was not responded to by him, Mr. Seybert did not doubt her warm and affectionate regard.

I ought here to say on what this regard was founded. It was the result of one of those incidents or accidents of life which cause us to realize that "truth is sometimes and not unfrequently stranger than fiction." The fact of Messieurs Chauncey, Seybert, Ambler, and myself dining together at the apartments of Madame de L. made us all feel a strong interest both in Madame de L. and her lovely little daughter. Mr. Seybert remained in Europe for a year or more after the return home of his fellow-travelers, and afterwards divided his time for many years between Europe and the United States, and thus had the opportunity, which they had not, of witnessing the development, in form and feature, as well as in intellect and beautiful nature, of the gifted daughter of Madame de L., and profited of the opportunity to offer to Madame de L. the advance of any funds she might require during the important period between girlhood and womanhood, to procure for her daughter the best instructors in languages and music, and such other accomplishments as she might deem appropriate and desirable for her.

A few years later, when Madame de L. found it necessary to obtain what is termed in France a divorce "*de corps et de biens*" from her husband, in order to protect a small remainder of her property, Mr. Seybert, believing in her ability to manage a large Hotel Garni, well and profitably, advanced to her the means of leasing and furnishing one, advantageously situated on the Rue Castiglione. The enterprise was so successful that, in an unusually brief period, Madame de L. was enabled to return to Mr. Seybert his advances, and leave for herself a modest but sufficient property for her support in her declining years.

It has been forty or more years since these services were rendered by Mr. Seybert, and Mlle. de L. had become within that period the wife of an honorable and respected citizen of Paris, and the mother of attractive and accomplished daughters worthy of their descent. But the services rendered by Mr. Seybert to her mother, now no more, and herself, will never be forgotten by the lovely and accomplished daughter, Madame de Saivre, who was for many years a constant and regular correspondent of Mr. Seybert, and whose affectionate and grateful remembrance was remarkably evinced, during and since, the illness which preceded his death.

Not hearing from him for a longer period than usual, she feared he might be ill, and wrote me asking me to inform her if he was seriously, or dangerously so. In compliance with her request, I gave her several times

information of him during his illness, writing on each occasion as encouragingly as I could, in view of her evident solicitude. When requested by you to write an obituary notice of Mr. Seybert, I thought it probable she could give me, in regard to his views on many subjects, information of interest to his American friends, and expressed in a letter to her the hope that it would be agreeable to her to do so. In reply, I received, in the month of June last, a letter from Madame de Saivre, from which I have copied and translated into English the following extract. It is impossible, I think, to read it carefully without coming to the conclusion that the course of action of Mr. Seybert, during the last half of his life, is most correctly and satisfactorily explained by it.

"During the long period (says Madame de Saivre) "of our acquaintance in France, he occupied himself, "at first, a good deal in reading scientific works, and "attending lectures on History and Chemistry, but it "seemed to me even then that his principal vocation "was in doing good. He aided the unfortunate and "improvident in their efforts to recover themselves, "and lead an honorable existence, and in order to en- "rich himself to promote this object, I know estab- "lished several persons in America; often, also, I have "known that he was not repaid money advanced by "him to persons who had profited of his confidence "and credulity, but were not in haste to repay the

" money borrowed by them. Nevertheless he did not
" weary in being charitable.

" Years ago Mr. Seybert spoke often to me of his
" studies in Spiritualism, and of a great mission with
" which he was charged here below. I confess I did
" not at the time divine what the mission might be. I
" asked myself only whether *mediums*, more or less
" sincere, were not abusing his confidence, in order to
" guide him, after their fashion, in their interests.
" Though I made many inquiries, Mr. Seybert never
" explained himself *clearly* on the subject *of this mis-*
" *sion*. But now, aided by the knowledge of his last
" will, I think I understand that beautiful mission which
" he has made the object of his life, and can inform
" you what has given rise to it.

" I recollect hearing Mr. Seybert say (I was then
" about sixteen years old), that he was discouraged and
" saddened, that he was studying uselessly, and seeking
" vainly the shortest and surest way to save his soul,
" which, in spite of his efforts, he could not see clearly.
" He had read in the Holy Scriptures that a rich man
" could no more enter Paradise than a camel could
" pass through the eye of a needle, and he was tor-
" mented with the thought that all his attempts to lead
" a good life were useless, as regarded a future life,
" *because he was rich*. Our poor friend was really very
" unhappy, and, I recollect, sought conference with our
" eminent religious men and casuists, and went even
" to Rouen to see the Prince de Croy, the Archbishop,

" on the subject. They all assured him, that this sen-
" tence was addressed to the *sinful* rich *only*, and not
" to those who gave of their goods liberally to the
" poor. In fine, they affirmed to him that *a really good*
" *rich man* should *fructify* his property, with the object
" of distributing it among the poor, and needy, and
" that on this condition only, could he be sure of reach-
" ing the Almighty after his death. From this mo-
" ment, dear sir, the vocation of our friend has been
" fixed. He has lived modestly, even economically,
" having reference to his large fortune, in order to ful-
" fill here below the Christian mission of the good rich
" man; that is to say, he has *fructified* (increased) the
" estate which God had confided to him, in order to
" be able to bestow more on those who suffer! Is not
" this exemplary and magnificent? May we not feel
" assured that God has already rewarded our friend?
" As regards myself, I am persuaded that he was drawn
" into his studies of Spiritualism, by the hope of finding
" in it some day the assurance that he was in the best
" of ways—that of charity."

We see in the above extract why Mr. Seybert exercised so close an economy in his personal expenses, and reserved his large benefactions until his death. Why he bequeathed so small a proportion of his fortune to his relations and attached friends, most of whom were in easy circumstances, knew his views, and expected nothing from him, and others who, like Mad-

ame de Saivre, knew and approved them, and would not have desired them to be changed.

Few men certainly have lived of more expanded benevolence, but he was especially devoted to the reputation and welfare of his native city, and his views were well defined as to what should be done by him from a sense of duty as a citizen, and to relieve want and suffering.

Many of our older citizens probably recollect that thirty or forty years ago he gave his time and expended large sums of money, in endeavoring to substitute extensively in Philadelphia, soda and other mineral waters at low prices, for alcoholic drinks. At a later period he improved, at considerable cost to himself and with much personal trouble, the *bread* of the city, and within the last eight years he gave to Philadelphia "a magnificent clock and bell, for which, at a special meeting of the Select and Common Councils of the City," on the 10th of July, 1876, the thanks of the city were tendered him. This clock and bell as yet, it is believed, unsurpassed by anything yet executed for a like object in our country, have been doing good service night and day since, "from the tower of Independence Hall," to a large proportion if not to all the inhabitants of our extended city.

The above services of Mr. Seybert to his fellow-citizens could not have been "done in a corner," and were *necessarily* known to many of them, but those who were acquainted with Mr. Seybert knew that his

object in rendering such services was *not to be talked about*, but *to be useful*. His acts of charity to individuals, manifold more numerous, were known only to their recipients and those whose co-operation was necessary to their being carried out. He was faithful all his life as far as possible to the injuction of our Saviour, in His sermon on the Mount, "Let not thy left hand know what thy right hand doeth."

In the commencement of this discourse, I alluded to traits of character in Mr. Seybert which I termed "peculiarities," but most of which might more properly be termed *exaggerated ideas of duty*. To one of these Madame de Saivre alludes in the extract read by me from her letter, in which she refers to the economical habits of Mr. Seybert, with the object of increasing the amount he purposed giving to the poor at his death. We may, I think, reasonably believe that the Almighty could not have intended that the liberal man, who gives liberally of his goods during his lifetime to the unfortunate and needy, should also economize closely in expenditures probably essential to his health and comfort in order to add to the large amount he designs giving at his death. The opposite of this I cite as one of the peculiarities of this most estimable gentleman. Another equally remarkable and equally creditable has attracted my attention in reading his will; this is *naming* the endowments authorized in the will after one or both of his parents. No one can respect more than the writer of this obitu-

ary notice does, the feeling of reverence and affection which dictated this direction; but his mother had died in his earliest infancy, eighty-one years ago, and his father fifty-eight years ago, and he, himself, was an aged man.

He could, therefore, not reasonably have been supposed wanting in respect and reverence for his parents in letting the endowments bear *his own name* instead of theirs, but the memories of his youth and the *fifth* commandment, "Honor thy father and thy mother that thy days may be long upon the land which the Lord thy God giveth thee," seem to have been always primary and paramount considerations with him.

Madame de Stael in one of her works, but which of them I cannot at the moment recall, expresses herself as having no *veneration* for any being in the universe but God and her father. Mr. Seybert has been for many years a sincere believer in the Christian religion, and of course could have used no language as little reverential to the Almighty, as that of Madame de Stael, but he has appeared to me to have had, ever since I have known him, a sincere veneration (which he would have been unnatural not to have had) for his father; for though that father was what the world would now perhaps call a *hard* father, Mr. Adam Seybert was so in consequence of his profound affection for his son, whom he desired to make at least his equal and if practicable his superior in the sciences of chemistry and mineralogy, to his knowledge of which he was mainly

indebted, at a comparatively early period of life, for both reputation and fortune, and the importance of which, in the future to his country and the world, he fully appreciated.

In speaking of Mr. Seybert's will I am reminded of his delay and difficulty in determining its provisions. This was the result of what he believed to be information from on high; that though he had long since passed the three score and ten years allotted to man, enough more years would be allowed him to enable him to witness great moral changes in the world, and the commencement of the "Heavenly Kingdom on earth." The excellent health he had for many years enjoyed, due to his regular habits and even temper, naturally aided in encouraging this idea, and but for a protracted illness growing out of a very slight cause, he would probably have postponed indefinitely signing and executing a will, which, in such a contingency, he would probably have deemed superfluous and perhaps undesirable.

The slight cause alluded to, was his wearing for the first time, about three years ago, at a dinner party in the country, some twenty miles from Philadelphia, a pair of boots not before used, the pressure of one of which for six or eight hours (the day being warm) upon a bunion on one of his feet, produced a serious swelling ending in inflammation of the whole foot and its suppuration, by which he was confined to his house and bedroom for many months; preventing, during

that period, his usual exercise in walking and driving, and causing thereby a corresponding diminution of appetite and strength. This great change produced, naturally, doubts in his mind as to his previous anticipations of his life being much longer extended, notwithstanding the assurances of the Spiritualistic mediums consulted by him, and a gradual though slow improvement in his health and appetite during the spring and summer of 1882, by visits to the Saratoga and Richfield Springs and the Coney Island baths, near New York, and these doubts caused him to consider and act on the presumption that he and those who looked to his life being prolonged were probably mistaken, and the early and close consideration by him of such a will as would carry out as nearly as practicable his views.

He had frequently in previous years, asked my opinion as to what I would do *in his place*, and with his views; that is to say, if I were unmarried and had no children and my near relations were all in easy circumstances. I had always replied to the inquiry that I knew of no charity which, in my opinion, would be so beneficent and valuable to Philadelphia as an institution having from the Legislature paternal powers to take up little boys and girls, neglected or abandoned by their parents, and who were crowding our streets either openly as beggars, or in the guise of "Newspaper boys," or on other pretexts, and who would necessarily grow up unfitted for any useful occupation;

but who, if under the care and control of a benevolent association, duly authorized to apprentice them to proper parties at the proper times, would be fitted for lives of usefulness in the occupations selected for them; that I believed there would be no serious difficulty in getting the proper legislation for such an institution, and in finding competent, honest, honorable and benevolent gentlemen to act as trustees in it, *if he would found it and act as one of its trustees during his life time*, and that such an institution would probably live and do its work for centuries, if the trustees, carefully selected, were not only authorized but *required* to fill *promptly* vacancies by death or other causes as they occurred. Mr. Seybert was impressed by these views, and at an earlier period of life, and previous to his belief in Spiritualism, when he could have acted as a member of the trust, would probably have adopted them. As it was, realizing that he could not reasonably expect to live more than two or three months, he deemed it best to give up the idea of an early trusteeship for the proposed charity, and do what he could to promote the object in his will which was signed, sealed and executed on the 25th of December last.

A reader of the will will find in one of the last clauses of it, that he directs his body to be "cremated at the Lemoyne Cemetery at Washington, Pennsylvania." I knew that cremation had been for many years preferred by him to the usual mode of sepul-

ture, or any other plan yet adapted for disposing of the human corpse, and here was one of his most remarkable singularities or peculiarities as I termed them in the first paragraph of this memoir: for it was whilst he was considering, or had perhaps determined on, cremation *for himself* that he was planning the transfer of the remains of his father from Paris, where they had for many years previous been interred in [I think] the Pêre la Chaise Cemetery; and those of his mother from her supposed last resting place many years earlier in Philadelphia, to the older portion of the Laurel Hill Cemetery of our city, where he wished their remains to be interred side by side, and where he expressed to me many years ago the desire that any ashes which might remain from the cremation of his own body should be used in sprinkling their graves, and causing the flowers and turf thus to grow fuller and more perfectly over them! Such was his respectful and affectionate reverence for both father and mother!

Peculiar and even paradoxical as Mr. Seybert sometimes appeared to be, he had the high respect and regard of those who knew him well, and during his last serious illness, he was not only comforted, but his life, it is believed, prolonged by the thoughtfulness of ladies, who sent him delicately prepared food which nourished and sustained him, and without which he would probably have died some months earlier than he did, but which made his more sanguine friends, even

as late as January last, hopeful of his recovery. About that time, it was ascertained by his able physician, Dr. Pepper, that "Bright's disease existed in a latent and "unsuspected form. Although, therefore, he con- "tinued able to drive out daily for some time, and "was able to discuss business subjects, as well as all "other topics, until within a very few days before his "death, he failed gradually but steadily," and his death, which occurred on the 3d of March following, was anticipated by him.

I have said, I think, enough in this memoir to give to those who may read it a fair impression of Mr. Seybert and his peculiarities. I do not think that any one understood him better than myself, or enjoyed more his confidence, and knowing his charitable views I was happy to give him counsel and aid when it was desired by him in investments, or in any other way. For these services he would, I have no doubt, have offered compensation if he had not been satisfied it would be declined, during his lifetime, and would not be expected at his death.

No one could have regarded death more firmly or with more composure, and it pleased the Almighty that his death should not be a painful one. To the last days of his life, he was occupied in charitable acts or suggestions, and directing as to the funeral services to be performed at his house, previous to the transfer of his remains for cremation at the Lemoyne Cemetery. His composure and firmness in death might naturally

have been expected in one who, not only in the close, but during the greater part of his matured life, had been governed in all his acts by a paramount sense *of duty.*

I met with, some years ago in a newspaper, the following lines, of which I have not been able to ascertain the author, but which seemed to me so applicable to Mr. Seybert that I gave him at the time a copy of them, which will probably some day be found among his papers:

I slept, and dreamed that life was beauty,
I woke, and found that life was duty;
Was thy dream then a shadowy lie?
Toil on, worn heart, unceasingly,
And thou shalt find that dream to be
A truth, and noon-day light to thee.

The Zone of Asteroids and the Ring of Saturn. By Professor Daniel Kirkwood.

(*Read before the American Philosophical Society, Oct. 5, 1883.*)

Evidence in support of the following theses was published by the present writer in 1866–7:

I.

In those parts of the zone of minor planets where a simple relation of commensurability would obtain between the period of an asteroid and that of Jupiter, the original planetary matter was liable to great perturbation. The result of such disturbance by the powerful mass of Jupiter was the necessary formation of gaps in the asteroid zone.

II.

The great division in the ring of Saturn may be explained by the disturbing influence of the satellites, and the more narrow division discov-

ered by Encke may be regarded with much probability as the effect of a similar cause.*

The recent able and noteworthy papers of General Parmentier,† of Paris, and Dr. Meyer,‡ of Geneva, have invested these older discussions of the same subjects with fresh interest and importance. The actual discovery of chasms in the asteroid ring was the result of a previous theoretical determination of the parts where void spaces would be produced by Jupiter's influence. The definite claims of the writer then are:

(1.) To have designated the theoretical positions of gaps in the zone of asteroids;

(2.) To have shown that these divisions actually exist; and

(3.) To have first assigned a physical cause for the divis ons of Saturn's ring.

A restatement of the principal evidence, showing the harmony of recent discoveries with the conclusions announced seventeen years since, is given below. The portions of the ring in which the periods would be commensurable with that of Jupiter are:

1. The distance 3.2776.

At this distance a planetary mass would make precisely two revolutions while Jupiter completes one. Hence, as has been frequently shown, a chasm in the ring would be the probable consequence of Jupiter's disturbing influence. How far is this theoretical inference sustained by facts?

An examination of the table of distances shows

Between 3.083 and 3.220	37	asteroids
" 3.220 and 3.357	0	"
" 3.357 and 3.494	8	"

That is, the part of the zone just within the distance at which a planet's period would be one-half that of Jupiter, contains the extraordinary number of thirty-seven minor planets, while the next space of equal breadth (that containing the distance 3.2776), is a total blank, not a single asteroid having yet been found within it. The exterior space immediately adjacent, and of the same extent, contains eight. The confirmation of the theory is thus most striking in precisely that part of the zone where we have most reason to expect it.

II. The distance 2.5012.

Here an asteroid's period would be one-third that of Jupiter. The order of commensurability would be less simple, but the results of perturbation would be of the same nature. The part of the zone included between the distances 2.30 and 2.80 contains 143 minor planets; 45 within the critical

* See Proc. A. A. A. S., 1866 and 1875; Met. Ast. Ch. xiii; Monthly Notice, R. A. S., Jan. 1869; Proc. A. P. S., vol. xii, p. 163; Smithsonian Rep., 1876; London Observatory, July, 1882.

† L'Astronomie, for June, 1883.

‡ Astr. Nach., No. 2527.

distance and 98 exterior to it. The average interval between adjacent members is 0.00349, while that containing the distance 2.5012—between Thetis and Hestia—is 0.05386, or more than fifteen times the average. Or, if we take spaces adjacent to the chasm and of equal breadth with it, we find twenty asteroids in the interior and eighteen in the exterior.

III. The distance 3.70.

Here five periods of a minor planet would be equal to three of Jupiter. The distance falls in the wide hiatus interior to the orbits of Hilda and Ismene.

IV. The distance 2.82.

At the distance 2.82 five periods of an asteroid would be equal to two of Jupiter. The difference between the two terms of the ratio is three, and hence the conjunctions would occur at angular intervals of 120°. Between the distances 2.753 and 2.803 we find twenty-three minor planets. In the next space of equal breadth, containing the distance 2.82, there is but one. This is No. 188, Menippe, whose elements are still somewhat uncertain. Between 2.853 and 2.903 we find ten asteroids.

Several other gaps have been noticed, but they become less distinctly marked as the cases of commensurability become less simple. Those considered are the only cases in which the conjunctions would occur at less than four points of the asteroid's orbit.

The orbit of Hilda is doubtless nearly, if not quite, the outer limit of the zone. Its mean distance is 3.9523, and in the space immediately beyond—at the distance 3.9683—an asteroid's period would be two-thirds of Jupiter's. It may be observed, moreover, that at the distance 2.063, just within the orbit of Medusa, a minor planet would make four revolutions to Jupiter's one.

Are the Gaps in the Zone Accidental?—In 1870, before half the asteroids now known had been discovered, Mr. Proctor, the well-known astronomer, wrote:

"The question may be suggested, however, is it not possible that the gaps thus apparent are merely accidental, and their accordance with the mean distances simply another accidental coincidence? It may seem, at first sight, that we have not as yet determined the orbits of a sufficient number of asteroids to decide very positively on this point. If another hundred were discovered, it might well happen, one would suppose, that the gaps would be filled up. But, in reality, the doctrine of chances is wholly opposed to this supposition. A law, such as that exhibited in the figure,* does not present itself without a cause. Irregularity is to be observed in all chance combinations, and the figure may be said to exhibit irregularity. But irregularities resulting purely from accident, never by any chance (when a fairly large number of cases is taken) simulates, so

* Mr. Proctor's diagram was merely a graphic representation of the groups and chasms of the zone.

to speak, the operation of law. Therefore we may assume that when many more asteroids have been discovered, the law exhibited in the figure will appear even more distinctly."*

One hundred and twenty minor planets have been added to the list since this passage was written, and, as was then predicted, the chasms in the zone have been rendered the more obvious.

In three portions of the ring the clustering tendency is distinctly evident. These are from 2.35 to 2.46, from 2.55 to 2.80, and from 3.05 to 3.22; containing forty-three, ninety-six, and forty asteroids, respectively. We have thus an obvious resemblance to the rings of Saturn; the partial breaks or chasms in the zone corresponding to the well-known intervals in the system of secondary rings.

The Rings of Saturn.

In the writer's Meteoric Astronomy, published in 1867, the same principle employed to explain the chasms in the ring of minor planets was shown also to account for Cassini's division in Saturn's ring; and, in a paper read before the American Philosophical Society, on the 6th of October, 1871, the division discovered by Encke was explained in like manner. The details of these calculations need not here be repeated, especially as Dr. Meyer has quite recently discussed the whole subject, not only confirming the conclusions of the present writer, but indicating also other parts of the ring where the satellites unite in exercising special disturbing influences. So exhaustive is Dr. Meyer's discussion that "the correspondence between calculation and observation, as to the division of Saturn's rings, would now seem to be complete."

OBITUARY OF JOHN FORSYTH MEIGS, M.D.

By William Pepper, M.D., LL.D.

(Read before the American Philosophical Society, Oct. 19, 1883.)

There are many men who, in their quiet, unobtrusive course, are of incalculable value to the community, and yet who leave but scant material for the biographer. The record of their life-work is to be sought in the cherished recollections of thousands who owe what

* Intellectual Observer, vol. iv, p. 22.

they hold most precious to their skill, energy and devotion.

Nowhere are such men found so frequently as in the ranks of the medical profession. Battles which call for the display of varied knowledge, ready resources, quick resolution, and unflinching courage and self-reliance in the face of tremendous dangers and responsibilities—and for these in such large measure as would win the world's applause if shown on some conspicuous stage—are waged by the physician in many a silent and secluded chamber against disease and death. And the man who turns aside from all allurements of personal ease, and, seeking no notoriety or other reward for his labors, save the consciousness of duty done, and of good results wrought out of perilous conditions, wages ceaselessly such warfare year after year, must rank as truly great.

Eminently such an one was the subject of this memoir, which, as I well know would accord with his own wish, shall be plain and brief in statement. John Forsyth Meigs was born in Philadelphia on October 4, 1818, and died there on December 16, 1882, at the age of 64 years. In an eloquent and instructive memoir of his eminent father, Charles D. Meigs, M.D., which he read in 1872, before the College of Physicians of Philadelphia, a full account is given of the staunch stock from which he was derived. Certainly no one who enjoyed familiar acquaintance with that remarkable man, the elder Dr. Meigs, as I myself

did, though his junior by half a century, could doubt that there would be transmitted to his children unusual and notable traits of mind and character. Of these children it is not fitting that I should now allude to any but the immediate subject of this sketch.

After being educated at Dr. Crawford's well-known school, John Forsyth Meigs began the study of medicine at the University of Pennsylvania, at the premature age of 16 years, and received his degree in 1838, when he was still under 20 years of age. He then served as Resident Physician in the Pennsylvania Hospital for eighteen months, and in April, 1840, he went abroad, remaining until August, 1841, a considerable portion of which time he spent in Paris, enjoying the then unrivaled advantages of that city for students of medicine. Immediately after his return he began the practice of medicine in Philadelphia, and from that time until a few days before his death, he continued the practice of his profession with almost unequaled assiduity.

His chief public service was in connection with the Pennsylvania Hospital, which institution he served as Attending Physician from 1859 to 1881, when he resigned* and was succeeded by his son, Dr. Arthur V.

*Resolutions passed Nov. 28, 1881, by the Board of Managers of Pennsylvania Hospital upon the resignation of Dr. J. F. Meigs:

Dr. John F. Meigs having presented his resignation as one of the attending physicians of this hospital, which, at his request, has been accepted, it is therefore

Resolved, That this Board desire to record their grateful recognition and appreciation of the faithful and efficient work done by Dr. Meigs in

Meigs. He was also Consulting Physician to the Women's Hospital, to the Blind Asylum, and to the Children's Hospital.

The services he rendered to the Pennsylvania Hospital were most devoted and loyal, as has been the case with so many of those connected, as managers or as members of the medical staff, with that venerable institution. For many years Dr. Meigs sacrificed a large part of whatever summer recreation he otherwise might have enjoyed, for the opportunity of devoting to the cases in his hospital ward more time daily than would have been possible had he chosen a term of service during the months when his private practice was most pressing in its claims.

He was a model Hospital Physician. His manners to the poor sick seamstress or servant girl in his ward were as kind, courteous and attentive as though he were in the chamber of his wealthiest patient. The care given to the study of each case, though with no thought of preparation for publication, was most thorough and minute.

the various positions in the medical department of this hospital, which he has filled for twenty-five years past, and which has added largely to the reputation our Institution now enjoys.

Resolved, That in addition to the faithful discharge of all his official duties, this Board recognizes the obligations of this hospital to Dr. Meigs for other ways in which he has testified his interest for the Institution,—notably in procuring for it pecuniary aid, and in the thorough manner in which he has completed the historical record of the hospital to the year 1876.

Resolved, That a copy of these resolutions be engrossed, signed, on behalf of the Board, by the President and Secretary, and sent to Dr. Meigs.

An insatiable reader of medical literature, he was ever acquainted with the latest views as to the nature and treatment of disease, and while his extensive opportunities of observation had rendered him conservative and critical of mere theory, he was always willing to recognize and profit by real advances in the healing art.

He employed a special assistant, whom he paid liberally, to make full records of every case under treatment in his wards, and I have had many opportunities of knowing that these records, embodying as they did his own accurate observations, and wise or ingenious suggestions, were admirable specimens of clinical work. But here, as in all his medical work, it was clear that his great and abiding interest was the welfare of his patients, and the actual relief of their sufferings.

During the entire period of his connection with the hospital, he took his full share of the public clinical teaching, which has been carried on there for 107 years. His lectures were unlike any others to which I have listened. With no pretence at oratorical effect, but with, on the other hand, the most perfectly natural and conversational style, there was such an air of candor and utter truthfulness, so much delicate and refined disclosure of his own nature and thoughts, upon many other subjects than the medical question immediately under discussion; such varied and rich illustration of the question from the stores of a curiously retentive memory, charged with all the details of

thousands of instructive precedents; and, above all, such uniform advocacy of the purest and highest and most disinterested aspects of medical work, as combined to render these lectures strikingly suggestive and valuable. But in addition to this routine work, though done with such spirit and enthusiasm as showed that it was always fresh to him, there were occasionally important original investigations suggested by him and carried out with his assistance. The most extended and complete of these special studies was that upon "The Blood in Malarial Fever," which was based upon an unusual series of cases of severe malarial fever from Southern seaports admitted to the Pennsylvania Hospital in 1866. The results of this investigation were highly important, and established, certainly for the first time in this country, certain additional facts in regard to the nature and mode of action of this singular poison. It was characteristic of the liberality and courtesy with which Dr. Meigs invariably treated his junior colleagues, that in publishing these results he insisted upon the names of his collaborators, who were then the resident physicians serving under him in the hospital, being associated in the authorship. How many times have I heard him, when about to leave the hospital, after several hours enthusiastic work in the wards, in the microscope room, or in the pathological laboratory, exclaim that if it was only possible he would prefer infinitely to spend his life in a hospital, devoting himself to original researches

upon the nature and treatment of disease, to any other conceivable plan of existence. I have mentioned these details because they illustrate the character of the man, and indicate the value of his public services, and especially of his influence upon all those who were fortunate enough to be brought into close contact with him in the discharge of these duties. It is no small tribute to the genuineness and disinterestedness of a man's devotion to science that, year after year, when overburdened with lucrative professional work, he should forego pleasure and much needed rest to spend laborious hours in such eager study in hospital wards as would stamp with distinction a young and enthusiastic investigator.

I have incidentally alluded to some of Dr. Meigs' writings, but it may at once be stated that, although not a voluminous author, he possessed admirable literary qualities and a most attractive style. The fact that he never sought any chair in either of Philadelphia's great medical schools, and that from an early age he was absorbed in the cares and fatigues of a large private practice, explain why he wrote no more and, why, with one notable exception, his writings were not of an elaborate character. He suffered also, as the sons of greatly distinguished men must do, from being viewed as an author in comparison with his gifted father, who was one of the most eloquent and facile writers ever produced by the medical profession of this country. But in fact the writings of Dr. John Forsyth Meigs

stand successfully the strictest criticism. As an example of his style, and as proof that he possessed literary gifts which, if leisure had been afforded, or if his ambition had been in the direction of more frequent publication, would have won him high rank as a writer, I would refer again to the memoir of his father, which seems to me a charming piece of biographical writing, abounding in evidences of correct taste and of delicate delineation of character, and written throughout in a pleasing, vivacious and sustained style of narrative.

The following list comprises the more important of his shorter writings:

April, 1847. History of Seven Cases of Pseudo-membranous Laryngitis or True Croup; with Remarks on the treatment, and the distinction between it and other Laryngeal Affections of Children. Vol. 13, N. S. Amer. Jr. of Med. Sciences, page 277.

October, 1848. A Practical Treatise on Diseases of Children.

April, 1849. History of Five Cases of Pseudo-membranous Laryngitis or True Croup, in three of which Tracheotomy was performed. Vol. 17, N. S. Amer. Jr. of Med. Sciences, page 307.

November, 1850. Pneumonia in Children. Vol. 1, N. S. Trans. Coll. of Physicians and Surgeons, page 5.

June, 1852. Remarks on Atelectasis Pulmonum, or Imperfect Expansion of the Lungs, and Collapse of the Lungs in Children. Vol. 23, N. S. Amer. Jr. Med. Sciences, page 83.

PROC. AMER. PHILOS. SOC. XXI. 114. 2I. PRINTED DECEMBER 1, 1883.

October, 1856. History of Three Cases of Intermittent Fever, Showing the Natural Course of the Disease. Med. Examiner, page 56.

October, 1859. Remarks on Chronic Gastritis, Duodinitis and Colitis. Vol. 1, Proc. Path. Society, page 243.

September, 1860. Clinical Lecture on Diabetes Mellitus, delivered at Pennsylvania Hospital.

June, 1860. Remarks on Transposition of Arteries. Vol. 2, Proc. Path. Society, page 37.

January, 1861. Remarks upon Intestinal Concretions in the Appendix Cæci, causing Perforation and Fatal Peritonitis. Vol. 2, Proc. Path. Society, page 77.

April, 1864. Heart-clot as a Cause of Death in Diphtheria. Vol. 47, N. S. Amer. Jr. Med. Sciences, page 305.

October, 1865. On the Pathological Appearances presented in Marsh Fever. Vol. 50, N. S. Amer. Jr. Med. Sciences, page 305.

April, 1868. On the Morphological Changes of the Blood in Malarial Fever, with Remarks on Treatment. Vol. 55, N. S. Amer. Jr. Med. Sciences, page 475.

January, 1869. History of Two Cases of Embolism; in one following Scarlet Fever, with recovery; in the second, connected with Disease of the Aortic Valves and Coarctation of the Thoracic Aorta, ending fatally. Vol. 57, N. S. Amer. Jr. Med. Sciences, page 24.

January, 1869. Address on the Opening of the New

Lecture and Operating Room of the Pennsylvania Hospital. Published September, 1871.

July, 1869. History of Two Cases of Cerebritis; one from unknown cause, the other traumatic, with recovery under active depletion. Vol. 58, N. S. Amer. Jr. Med. Sciences, page 146.

November, 1872. Memoir of Charles D. Meigs, M. D. Vol. 1, N. S. Trans. Coll. Phys. and Surg., page 417.

January, 1875. A Case of Pneumo-Hydropericarditis. Vol. 69, N. S. Amer. Jr. Med. Scs., page 81.

September, 1876. A History of the First Quarter of the Second Century of the Pennsylvania Hospital.

September, 1878. Atelectasis Pulmonum. Proc. Obstet. Society.

January, 1879. Cases of Collapse of the Lungs and Cyanosis in Young Children. Amer. Jr. Obstetrics, Vol. 1, page 79.

February, 1880. Lecture on Water.

1880. Annual Address before the Alumni Society of the University of Pennsylvania.

The work, however, by which Dr. Meigs will be longest and best known, is the treatise on "Diseases of Children," the first edition of which was published in 1848, and which immediately attained the position of a standard authority. A second and third edition appeared in rapid succession, and were quickly exhausted, after which, owing to his excessive occupation, it was allowed to become out of print. In 1869, he requested

me to associate myself with him in the task of bringing the work up to date, and the fourth edition, which appeared in 1870, has been followed by three others, the last having been published in 1882. The estimation in which this has come to be held may be appreciated from the language of the London *Lancet:* "It is a work of more than 900 good American pages, and is more encyclopædical than clinical. But it is clinical, and withal most effectually brought up to the light, pathological and therapeutical, of the present day. The book is like so many other good American medical books which we have lately had occasion to notice; it marvelously combines a résumé of all the best European literature and practice, with evidence throughout of good personal judgment, knowledge and experience. There are few diseases of children which it does not treat of fully and wisely in the light of the latest physiological, pathological and therapeutical science."

But unquestionably, it is as the wise and trusted physician that Dr. Meigs will be most vividly and fondly remembered, so long, at least, as any of those survive who had the benefit of his ministrations and advice. I doubt whether there could be found, in any other large city, prominent physicians occupying precisely the relation to the community which has, for a hundred years past, been borne by a succession of eminent medical men in Philadelphia.

For the most part, as communities enlarge, the leading physicians are forced by the demands upon their

time to assume more and more the role of consultants, and to abandon, in large measure, the more intimate and personal relations with their patients which is occupied by the family physician. But in this city, despite its rapidly enlarging proportions and population, the case has always been different. There have ever been physicians in Philadelphia, whose important hospital positions, popular and authoritative writings, and eloquent teachings, have combined to render deservedly illustrious, but who have continued willing to devote themselves to the daily routine of family practice. It need not be indicated that such a course has displayed singular unselfishness; since such combined labors have involved almost superhuman exertions and application, while their personal services have been rendered for remuneration scarcely greater than that received by their less experienced and less eminent colleagues. But this self-sacrifice and devotion to the interests of their patients, has been repaid by a degree of affectionate gratitude and loyal attachment on the part of the community, which has rendered almost unique the position of the leading medical men of Philadelphia. Of this long line of distinguished practitioners Dr. John Forsyth Meigs was an excellent example, and it is scarcely too much to say that, owing to a variety of causes which cannot be here discussed appropriately, he was the last of that line. Whether the people of Philadelphia will gain or lose more by the changes which, during the past decade, have rapid-

ly come over the relations between the medical profession and the community, is an open question. But it is evident that such changes were unavoidable, and the only matter of surprise is, that they could have been postponed so long by the conservative spirit, so strongly prevalent here, and by the respect paid by the medical profession to its deeply rooted traditions. In this relation of trusted and confidential adviser, Dr. Meigs could not have been surpassed. Of spotless integrity and purity of character; with a lofty conception of his duty as a physician, and with unselfish devotion to the pursuit of medical science; with such courtesy and charm of manner and conversation as made him one of the most agreeable companions; with infinite tact, patience, gentleness and sympathy with the sick and suffering; and yet with firmness of will, vigorous energy, calm and dignified self-reliance which commanded implicit confidence and obedience in the hour of most urgent and deadly danger; it is not easy to conceive or portray the large and important place such a man filled in the lives and affections of hundreds or thousands who cherished him as their physician. I well know that this poor tribute would be re-echoed in stronger and warmer accents from many a sick chamber, which is to-day deprived of its brightest cheer and strongest comfort through his death.

But few details of his private life need be added to this sketch. He was married Oct. 17, 1844, to Miss Ann Wilcocks Ingersoll, daughter of the late Charles

J. Ingersoll, Esq., and was so unfortunate as to lose this amiable woman by death on Dec. 30, 1856. He remained faithful to her memory and never married again. Eight children were born to him, of whom the eldest and the youngest died. His son, Dr. Arthur V. Meigs, after graduating at the University of Pennsylvania in 1871, has devoted himself with signal success to the profession followed by his distinguished father and grandfather, and already occupies the same important public positions in connection with the Pennsylvania and Children's Hospitals, which were formerly held by his father.

His habits of life were extremely simple and almost austere. He clung to the simplicity of his early days, and lamented the luxury of our own time. His constant and absorbing occupation, as well as his own tastes, prevented him from moving to any considerable extent in general society, or, during his later years, from even attending the meetings of the scientific or medical societies to which he belonged. Although he worked incessantly and arduously, it is certain that his strength was never great nor his health robust. He had two serious illnesses, pleuro-pneumonia in December, 1854, and a second attack of pneumonia, complicated with hemorrhage from the lungs, in December, 1863. His last illness was also pleuro-pneumonia, which was contracted in December, 1882, by exposure during a professional visit, when he was reduced by a heavy cold; it ran a rapid course, and ended fatally on the eighth day.

Stated Meeting, October 19, 1883.

Present, 12 members.

President, Mr. FRALEY, in the Chair.

Letters of acknowledgment were received from the Fayenbaya Observatory (112), the Pennsylvania Historical Society (113), and the Franklin Institute (Cat.).

A letter of envoy was received from the United States Department of State for the Government of the Netherlands.

A letter from Edmund de Schweinitz, President of the Society for the Propagation of the Gospel among the Heathen, dated Bethlehem, Pa., October 9, 1883, requesting the return of the Zeisberger and Perlæus MSS. to their owners, was read and referred to the next Stated Meeting for consideration, the Curators being instructed to examine into the subject in the meantime and report. (See page 284.)

Donations for the Library were received from the Royal Academy of Science at Rome; Royal Venetian Institute; Société de Géographie and Revue Politique, at Paris; Société de Geographie Commerciale, Bordeaux; Observatory at San Fernando; London Nature; Boston Natural History Society; Rhode Island Historical Society; New York Academy of Sciences; Cornell University; Journal Medical Sciences; Chemical Journal; United States Naval Institute; United States National Museum; and Mr. H. T. Cresson, of Philadelphia.

An obituary notice of Dr. John Forsyth Miegs was read by Dr. William Pepper. (See page 266, above.)

Mr. T. U. Walter was excused from preparing an obituary notice of the late John Trautwine, as he had already read one before the Society in Washington, which would be published.

The death of Dr. J. Lawrence Smith, at Louisville, Ky., October 12, aged 64, was announced.

A memoir entitled "The history of the Mexicans, from their Paintings," was communicated by Mr. Henry Phillips, Jr., being an annotated translation of the Ramirez MS.

A memoir on the "Course and growth of the fibro-vascular bundles in Palms," by J. C. Branner, was read by the Secretary.

Dr. Frazer exhibited a map of Radnor township and the adjoining districts of Delaware and Chester counties, on which he had delineated the Sienite belt and the outcrops of Serpentine, the stratigraphical relationships of which he discussed, dissenting from Mr. Rand's theory of their echelon structure and exogenous origin.

A communication was read from Mr. Hillborn T. Cresson, of the Academy of Natural Sciences of Philadelphia, respecting the minutes of March 15, 1883, Proceedings of American Philosophical Society, pages 648, 649.

"The statement that the instruments in question were studied by Mr. Cox is a mistake. The gentleman above named (Mr. Cox) was employed by me as a professional musician to verify and illustrate, with the Boehm flute, the points of a lecture upon Aztec music, delivered by me, before the Academy of Natural Sciences of Philadelphia during their seance of April 17th, 1883, having previously furnished him with a score showing all the notes, fingering and stoppings necessary, and by reference to which he so manipulated the instrument in question that, upon the Mexican *flutes* or *flageolets* the entire *chromatic scale* was obtained; and upon those instruments denominated by me pitch-pipes or whistles (made of like material) an octave was obtained; also, a *ninth*, eleventh and twelfth, the tenth note being missing (or the instrument made to produce it lost, or otherwise destroyed, and it will rest with musical experts to determine whether this note really existed). It is due Mr. Cox to state, that I mentioned him in my pamphlet entitled 'Aztec Music,' on account of the valuable hints he gave me in regard to modern music, formation of orchestras, &c., as my musical knowledge is limited. It was simply my intention, as an archæologist, to call the attention of musical experts to facts first observed by me while arranging certain collections of antiquities in France and Italy, trusting that they might be of interest, and serve to aid investigations in this branch of ethnology, about which little is known at present. It is necessary to make a distinction between the two kinds of instruments borrowed by me from your Society, as they are entirely different in construction and character, viz.: four-holed flutes, made of baked clay or terra-cotta, and those instruments of like material, which I have denominated 'pitch-pipes,' both kinds of which instruments are of Mexican origin. I beg leave to ask that, at your next stated meeting,

you will kindly correct the mistake above shown and published in your Proceedings, and kindly insert the following, viz. :

"'The Curators reported the safe return of the four-holed Mexican flutes or flageolets of terra-cotta, and the "pitch-pipes" or whistles of like material, which were borrowed and studied by Hillborn T. Cresson, who found that the first-mentioned four-holed clay flageolets could be made to produce the entire *chromatic* scale by proper manipulation and finger-stopping. The Mexican whistles or pitch pipes gave in regular succession, from tonic to octave, a full diatonic scale; also, a ninth, eleventh and twelfth existed, *"the tenth being absent,"* giving in all an *octave* and a *quarter.*'

"I regret to say that this is somewhat long, yet the facts deduced by the investigation of these instruments, owned by your honorable Society, prompt me to ask you to record them, merely claiming that they are interesting facts, *and, if I am correct, first noticed by myself.* Please state to your Society that, for the past eight months, I have devoted my spare time to the arrangement and classification of the Mexican antiquities contained in the Poinsett and Keating Collection, and that I hope in a few weeks to have these unique specimens of art so arranged that they can be properly labeled and catalogued."

Pending nominations, Nos. 985 to 1006, were read.

And the meeting was adjourned.

Stated Meeting, Nov. 2, 1883.

Present, 9 members.

President, Mr. FRALEY, in the Chair.

After reading the minutes it was resolved that the Secretataries be instructed to cancel the concluding part of the rough minutes of the last meeting.

Letters of acknowledgment were received from the Royal Society at London (102, 110 and 111 to complete set), and the Statistical Society, October 15 (112).

A letter of envoy was received from the United States Naval Observatory.

Donations for the Library were received from the Geological and Trigonometrical Survey of India, the Danish Society of

Antiquaries, the Congress of Americanists; the Societies at Königsburg, Giessen and Geneva; the Geographical Societies at Vienna, Paris, Bordeaux and London, the Royal Academies at Berlin and Dublin; Zoological Societies in Paris and London; Professor Paul Albrecht, of Brussels; Revue Politique and Revista Euskara; the Royal, R. Asiatic and Linnæan Societies in London, Greenwich Observatory, Cornwall Polytechnic Society; Boston Natural History Society; American Academy of Sciences; American Journal of Science; New York Observatory, United States Observatory; Franklin Institute; Mr. Henry Phillips, Jr., and the Mexican Museum.

The death of Oswald Heer, of Zurich, at Lausanne, September 27, aged 74, was announced by the Secretary; the reading of a letter from Mr. Leo. Lesquereux, of Columbus, was postponed to the next meeting. (See page 286.)

The death of Joachim Barrande, at Prag, aged 83, was reported by the Secretary.

Mr. Chas. A. Ashburner gave a brief description of Dr. Kintses's fire-damp indicator which he had recently examined in conjunction with a Committee of the Franklin Institute.

Although he did not feel at liberty to state the conclusions to which the Committee had arrived in regard to this special apparatus, he expressed grave doubts as to the practicability of any such appliance to prevent mine explosions from fire-damp, and the consequent loss of life. Fire-damp is not the most deadly foe of the coal miner as is popularly supposed. It is an acknowledged fact that anthracite contains the greater quantity of fire-damp; and greater risks from gas explosions are experienced in anthracite mines.

He stated that in the decade from 1860 to 1870 less then 11 per cent of the fatal accidents in the Pennsylvania anthracite mines resulted from fire-damp explosions; while during the year 1882 only 8½ per cent of the fatal mine accidents were to be attributed to this cause. In most cases the fire-damp, whose presence was already known, and therefore no automatic indicator was necessary to locate it, was fired either through the carelessness or recklessness of a miner, from a neglect to comply with the superintendent's orders, or from criminal disobedience to the mine laws.

In his judgment, in no case during the year 1882 would an automatic indicator have prevented an explosion. The greatest foes of the coal miner are his negligence, his disobedience and his recklessness.

The experience of the English miner with automatic fire-damp indicators, particularly Ansell's, which the speaker thought a more sensitive fire-damp detector than Dr. Kintses's, goes to prove that the use of such instruments is not practical. The mine laws if rigidly enforced would diminish the risk of fire-damp explosions and the resulting loss of life more than any other means. The experience of Mr. Ashburner in fiery mines was adduced in support of his views.

The reading of pending nominations Nos. 985 to 1006 was postponed.

The Report of the Curators on Bishop de Schweinitz's letter was read and accepted, and the resolution recommended therein was agreed to. (See below.)

Mr. Fraley reported that he had received and paid over to the Treasurer the interest on the Michaux Legacy due October 1st, amounting to $132.43.

Mr. Lesley was authorized to insert in the minutes the following correction of the note in his communication on the Progress of the Second Geological Survey of Pennsylvania, in Chester county, read January 19, 1883 (Proceedings No. 113, page 539, lines 17, 18), which he desired to have read as follows:

"The delay in the publication was caused by an unforseen and unavoidable delay in the receipt of Dr. Frazer's notes which form the latter part of the volume."

A Committee of five, consisting of Dr. Brinton, Mr. Price, Dr. Horn, Mr. Phillips and Dr. Frazer was appointed to report what improvement, if any, can be made in the mode of balloting for members, and the meeting was adjourned.

Letter of Bishop de Schweinitz.

To the President and Directors of the American Philosophical Society:

GENTLEMEN: In accordance with a resolution adopted by the Directors of the "Society for Propagating the Gospel among the Heathen," I herewith respectfully request you to return, at your earliest convenience, the seven Manuscripts by Zeisberger and Pyrlæus on Indian languages, which Manuscripts are the property of said Society, and which were deposited in your Library subject to a call from our Board. Their titles and the fact that they were deposited by our Society, are set forth in Vol. I of your Transactions, 1819. I inclose a list of these Manuscripts.

The reason why we now claim them is, that the Church has made com-

plete arrangements for preserving all its documents and papers here at Bethlehem; that its library and collection of manuscripts are properly ordered and displayed in its "Archives;" that a most valuable library of Moravian literature has recently been presented to us; and that we wish to bring together all the papers which we own, especially with regard to the Indians, and arrange them in our collection. At the time that the Manuscripts for which we ask were deposited with the American Philosophical Society, none of the conveniences existed which we now have for preserving such documents.

I remain, gentlemen,

Yours, very respectfully,

EDMUND DE SCHWEINITZ,
President of the S. P. G.

BETHLEHEM, PA., October 9th, 1883.

Transactions of the American Philosophical Society, Philadelphia, Vol. I, 1819. By its Historical and Literary Committee.

p. xlvii. "*Deposited by the Society of the United Brethren of Bethlehem:*"

1. Deutsch und Onondagoisches Woerterbuch, von David Zeisberger. 7 vols. 4to.

p. xlviii. 2. Essay of an Onondago Grammar, or a short introduction to learn the Onondago, alias Maqua Tongue; by David Zeisberger. 4to, 67 pp.

3. Onondagoische Grammatica; by the same. 4to, 87 pp.

4. Another Onondago Grammar in the German language; by the same. 4to, 176 pp.

5. Affixa Nominum et Verborum Linguæ Macquaicæ. Auctore Chr. Pyrlæo. 4to, 25 pp. [With this work are bound several Iroquois Vocabularies and Collection of Phrases, the whole together making 178 pp. 4to.]

6. Adjectiva, Nomina et Pronomina Linguæ Macquaicæ, cum nonnullis de Verbis, Adverbis ac Præpositionibus ejusdem linguæ. Pyrlæus. 4to, 86 pp.

7. A Collection of Words and Phrases in the Iroquois or Onondago Language, explained into German. By the Rev. Chr. Pyrlæus. 4to. 140 pp.

Report of the Curators on the subject of the Zeisberger and Pyrlæus MSS. November 2, 1883.

It appears to the Curators that these MSS. were deposited by "The United Brethren of Bethlehem," and therefore cannot be given up except to them or by their order. The present demand comes from the "Society for Propagating the Gospel among the Heathen." We have, therefore, no right to surrender these MSS. to an alien Society.

If the "Society for Propagating the Gospel, &c.," be the successor of "The United Brethren," we should be formally and legally notified to that effect, and likewise the resolution of request should be under seal. If we were to accede to this demand without a greater knowledge of the circumstances we might be liable to a demand from the real owner of these MSS. with which the Society could not comply. We, therefore, recommend that the Society adopts the following resolution :

That Bishop Schweinitz be requested to inform the Society by what right the "Society for Propagating, &c.," demand from us these MSS. deposited by "The United Brethren."

PHILLIPS,
GEO. H. HORN, } *Curators.*

Nov. 2, 1883.

Notes of Reference Appended.

Deposited, 1819. Trans. Vol. I, page

1865. Dec. 1. (Proc. Vol. X, p. 187.) D. W. Fiske writes in relation to the Zeisberger MSS.

Dec. 15. (Proc. Vol. X, p. 193.) Letters read in reference thereto. Contents not given.

Literary Committee made a recommendation which was referred to the Secretaries to report on.

1866. Feb. 16. Vol. X, p. 205. The Secretaries reported they had found these MSS. noted as deposited, &c. The United Brethren were requested to allow the American Philosophical Society to publish them.

March 2. (Vol. X, p. 207.) Mr. Fraley states that the United Brethren desired themselves to publish these MSS.

March 16. A letter from Bethlehem *in ea re* read.

The matter ended there, and nothing further appears on the minutes to this day.

PHILLIPS,
GEO. H. HORN, } *Curators.*

Nov. 2, 1883.

Letter of Leo Lesquereux.

Oswald Heer, the celebrated Professor of Zurich, was born at Glaris in 1809. His father was a doctor. He first studied theology, and was ordained as minister, but afterwards studied medicine, and became interested in the science of Natural History. He has lived at Zurich since 1832. In 1837 he was Professor either at the University or at the Polytechnic School, and Director of the Botanical Garden. He was for a few years a member of the Council of Zurich, but resigned his seat to be able to attend entirely to his studies. In 1869 Zurich received the celebrated scientist as an honorary citizen (member of the city Bourgeoisie).

The letter of communication of the family, 29th September, says only

this: "Prof. Dr. Oswald Heer was called to God at the age of 74 years, 27 days, after a short illness. He died at Lausanne on the 27th." Berthoud, who writes me also on the 29th, gives me a few details on Heer's last days. He says: "I come to be with you to deplore the loss of your friend and to share your sorrow. Heer is dead. He was of late very tired. In order to get some rest he went to Montreux, that fine warm place on the borders of the Lake of Geneva, where he expected to regain some strength for new works. There he had after a few days an attack of bronchitis. Well knowing the danger of that disease for a man advanced in years, he hurried to his brother at Lausanne, where he died the day after his arrival."

Heer had worked the whole winter beyond human forces, to bring to a close the seventh volume of his Arctic Flora which came out in July. The great Swiss exposition of industrial products, held at Zurich, gave him constant occupation and some excitement by the numerous visits he received. The meeting of the Society of Natural History of Switzerland of which he was President was also held at Zurich, increasing his work of course, and forcing him to long and severe exertion. In his last letter, end of August, he writes me that his task is nearly finished, and that he feels that it is time to close his work.

A Swiss journal announcing the death of Prof. Heer says, that the loss is irreparable, and this expression is echoed by many. The loss of a member of our poor humanity is never irreparable; that of Heer has left a vacant place which will be unoccupied for a long time to come. Why? Allow me to trace a short outline of his career as the more fitting answer to the question.

I know little of the early years of the celebrated Professor of Zurich. His family came from St. Gall. He studied first theology in Zurich, I believe. But then, prompted by his ardent love of nature, he abandoned his calling for the study of entomology and botany. From the beginning of his career, he took a high standing in the world of science by the publication of a memoir on the relation of the insects with the plants, enumerating and describing a large number of species of plants with the insects related to each by their habitat, their food, their mode of life, etc. He had already given his attention to fossil botany, when, in 1848, he began to collect materials for the preparation of a fossil flora of Switzerland and the adjoining countries. He went to work, helped by most favorable circumstances; by the rich collections of the Museum of Zurich; by the communications of numerous friends, among them the celebrated Alex. Braun, later Professor of Botany at the University of Berlin, and Director of the Botanical Garden; especially by the resources of a rich lady, Mrs. von Bumine. This lady, endowed with a great love of science and of admiration for the works of Heer, who was already a professor of reputation, opened upon her property near Lausanne quarries and tunnels for the discovery and collection of fossil plants, materials which were sent to Zurich by tons to be studied by Heer. A large part of the specimens figured in

the *Flora tertiaria Helvetica* came from that source. One cannot read without a deep feeling of admiration a note of thanks written by Heer in honor of that lady in the beginning of the third volume of that work. The third volume ends the Tertiary Flora of Switzerland. The work was then supposed to be complete, but a fourth volume, *Flora fossilis Helvetica* was published in 1876, containing descriptions and figures of plants of the Carboniferous, the Trias, the Jurassic, the Cretaceous and of the Eocene of Switzerland. This great work in 4to, with a very large number of splendid plates, is too well known to demand description. It has given to the author the first place in the ranks of Phytopaleontologists of our time.

A kind of antecedent résumé of this work was already published in 1865 under the name of *Die Urwelt der Schweitz* (the Ancient World of Switzerland). It is a large F° volume of 600 pages, splendidly illustrated by figures representing fossil remains of plants and animals of the different geological periods. The best proof of the worth of the volume is the fact that though relating only to the paleontology of the geological formations of Switzerland, the book has had already three or four editions, and been translated into six different languages.

At this time Heer was requested by professors and directors of museums to determine and describe numerous collections of fossil plants, and as a result of his researches published many separate memoirs on the plants of divers localities of Europe. Among the more important ones I may mention: The Flora of the clays of Borey Tracy, England (1861). The Baltic Miocene flora; the Eocene flora of Bornstaedt (1863 and 1869). The Cretaceous flora of Moletin; that of Quedlinburg (1871). The Phyllites cretaciés of Nebraska, the Fossil flora of Alaska, the fossil plants of Vancouver, contributions to the fossil flora of Sumatra, and a number of others, half a dozen of which are mentioned in the catalogue of Heer's work by Schimper.

During this time Heer was already at work on his most important production, the *Flora fossilis Arctica*, which, begun in 1862, was finished by the publication of the seventh volume a few months before his death.

Considering only the large number of the publications of Heer, they already constitute a weighty monument as the result of the life of a man. But that number is not the essential value. Other paleontologists, Brongniart, Sternberg, Unger, Goeppert, Schimper, Lindley and Hutton, among the illustrious dead, have left works which may be compared to those of Heer, though in a far reduced degree of value. None of them, however, has raised fossil botany to a high degree of importance in the scientific world. None of them has, like Heer, opened new fields for the exercise of the mind, and prepared for vegetable paleontology an honorable place in the domain of science enlarged by researches in that specialty.

In the Arctic Flora Heer has brought to light, for the polar regions of Greenland, Spitzberg, Sachalin, a subtropical vegetation, attesting, during the Tertiary period for those northern regions, a climate about like that of Florida and the Gulf shores at the present time. He has recog-

nized an analogous kind of vegetation in following the data furnished by remains of fossil plants southward to the shores of the Baltic sea, and even to those of the Mediterranean in Italy. This fact of course concerning the distribution of plants during the Miocene or Tertiary period has forcibly modified the views formerly admitted respecting the physical circumstances which have governed the earth during geological times, and has compelled physicists and geologists to renew their researches for the solution of important problems concerning the distribution and the cause of heat, and changes in the temperature of the globe. Heer has described also a Cretaceous flora from Greenland bearing evident relation to that of the same period observed in North America and in Europe; a flora representing a number of types which, persisting through the floras of the more recent formations, are still present in the North American vegetation of the present epoch. He has thus evidenced by his Arctic flora the gradual development of vegetable types since the times when the first traces of dicotyledonous plants are recognizable. He has compelled the admission of vegetable paleontology into the domain of geology by the manifest determination of the age of any formation from the characters of its plants only. With only one mistake on that subject has he been unjustly reproached, viz., his reference to the Tertiary of three or four Cretaceous leaves of which he had merely poor sketches to base his determination on.

The noble character of Heer has greatly contributed to give to his works a degree of authority superior to that acquired by any paleontologist before him. Simple, modest in the highest degree, of a serious though contemplative mind, his life was resumed on the fulfillment of the duty of every day. When the University of Switzerland was established at Zurich, he had been named Professor of Natural History and Director of the Museum. His lectures at the University were always followed by a large number of students; so full of interest were they that even strangers and common town-people requested the privilege of attending them. He never missed an opportunity to show his deep interest in the scientific and moral progress of the students. Even in his days of sickness (for all his life he has had to fight against attacks of severe illness), he gave his lessons in his own room, lecturing from his bed. He had been called once by his countrymen to a highly honorable position as a member of the Council of State; but he found that the new duty required too much of his time, and he gave in his resignation in order to continue without hindrance his scientific pursuits.

What can I say more of the friend with whom I have been in intimate relationship long years. Heer united in himself a powerful intellect, trained by severe studies, with the simplicity of a child and the conscience of a true Christian. His works are the expression of the principles of his life.

L. Lesquereux.

PROC. AMER. PHILOS. SOC. XXI. 114. 2K. PRINTED JANUARY 10, 1884.

Stated Meeting, November 16, 1883.

Present, 12 members.

President, Mr. FRALEY, in the Chair.

Mr. P. C. Garrett was introduced to the presiding officer, and took his seat.

A photograph of the Chev. Damiano Muoni was received through Mr. Phillips for insertion in the album.

Letters of acknowledgment were read from the Boston Public Library (XVI, i); American Antiquarian Society (XVI, i); New Jersey Historical Society (XVI, i); United States Military Academy (XVI, i); State Historical Society of Wisconsin (XVI i,), and the University of the city of New York (113, i).

A letter of envoy was received from the Academy of Sciences at Rome.

Donations for the Library were reported from the Mining Engineers at Melbourne, Mad. C. Royer of Paris, the Geographical Commercial Society, Bordeaux; the Geological Society and Señor Goodolphim of Lisbon; London Nature; American Astronomical Society, Boston; Harvard University; Mr. Scudder, Mr. Phillips, the Brooklyn Library, the American Chemical Journal, Mr. Gatschet, the editor of Scandinavian, and the Astronomical Observatory of Mexico.

Dr. Brinton read an obituary notice of Oswald Heer, in a letter from Mr. Lesquereux to Mr. Lesley.

The death of Dr. John Lawrence Le Conte, one of the Vice-Presidents of the Society, at Philadelphia, November 15th, aged 58 years, was announced by the Secretary.*

*John Lawrence Le Conte, the son of Dr. John Le Conte, was born May 13th, 1825, in New York, and graduated at the College of Physicians and Surgeons in 1846. He traveled extensively on this continent on tours of scientific investigation. He served as surgeon and medical director in the volunteer and regular armies during the war of the Rebellion. In 1873 he was elected President of the American Association for the Advancement of Science. He was an active member of the Academy of Natural Sciences in Philadelphia. Dr. Le Conte was a son-in-law of the late Judge Grier, of the United States Circuit Court.

Mr. Lesley desired to express his feeling that while the Society has sustained a serious loss in the death of one of its estimable Vice-Presidents, science has suffered a lamentable blow by the withdrawal of one of the best investigators and one of the truest philosophers that ever did duty in her service. Not a common soldier only has fallen—not a non-commissioned officer—not a mere colonel of a single regiment in her army—but a general of high rank, a leader of forces, one who could plan and execute the manœuvres of a large and long campaign, an organizer, a ruler in her realm.

My private grief, said the speaker, at the loss of an old and intimate personal friend gives me no peculiar right to tell his virtues and abilities in this hall where he has been known and honored for so many years; but it gives me the power to speak of these virtues and abilities with the confidence of absolute knowledge. Others have known and loved him, and will regret his death, and will speak of him affectionately and respectfully inside and outside of this hall. But it was my good fortune to be one of his special companions for the past thirty years; and he often expressed the wish that if I survived him I would place on record some memorial of his life. Once, when I felt vigorous and hopeful, I promised to gratify his wish, although he was the younger of the two, and had a natural right to give what he desired to receive. But now, how is it possible to do more than say: "Le Conte is dead, the precocious youth, the affectionate son, husband, father and friend, the just and truth-loving man, the accurate and precise observer, a master in the divine art of classifying facts, a perfectly trained and nobly developed genius in science."

Le Conte is a famous name in American science. The foundations of its fame were laid by the father, and built up by the son. Both these have passed away from the eastern shore of the continent; but on its western shore two brothers, children of the father's brother, prolong and enhance the reputation of the name.

A memorial of the life of our fellow member and friend would be incomplete without a personal description of old Major Le Conte, to whose vigorous intellect, excellent common sense, and great experience in zoological studies, John owed not only his extraordinary abilities, his aptitude for mathematics, his eye for form and color, his exactness, his imagination, his love of the study of languages, his taste for historical metaphysics, and especially mythology, and his pronounced capacity for practically putting things in order and managing affairs, but also the opportunity for cultivating and displaying all these various, and, as many people vainly imagine, contradictory mental powers.

I say vainly imagine. For, it is a vulgar prejudice to suppose that a life spent in counting the number of segments and legs of bugs, and describing the microscopic foliation of their antennæ, incapacitates a man for comprehending the Mécanique Celeste, or the writings of Plotinus; for the enjoyment of the Mahabahrata, or the safe conduct of his hereditary estate. What stamps the character of Le Conte as a genius is precisely

what gives the lie to this vulgar prejudice. He was as fine a mathematician as he was minutely true with the microscope. His wide and varied learning checked any tendency to narrowness in study, and gave him a power and richness of language which reacted on his reason to enrich it with a copious store of generous and noble ideas. The infinite variety of insect forms was not more attractive to him than the infinite variety of words in the languages which he studied; nor the infinite variety of myths with which the imagination of past ages has attempted to explain, or at least to portray, the mysteries of the Universe. Will it excite surprise then in any well equipped mind, that the skill which nature gave him to arrange facts of the organic world, relationships of numbers, and the ideas of men, availed him quite as well in the leasing of his father's storehouses in New York, the reorganization of the wards of an army hospital, and the conduct of the business of the United States Mint?

All this went together, and comes quite natural to a superior genius. It matters little what the man regarded as work, and what he regarded as play; his work was creation and recreation in one, and his recreation was all good work. Every hobby a true genius mounts becomes under his management a trained war-horse or sagacious hunter. The contradictory occupations of such a man would be a reproach to less gifted mortals; but in the career of such a man they are merely alternately diverging and converging careers of usefulness. The recognition of this truth by Major Le Conte was gratefully acknowledged by his son in narrating such anecdotes as the following:

Young Le Conte was put to school at St. Mary's College, in Georgetown, D. C. The discipline of the class-room was very strict. Everybody was kept to silent study; none could leave his seat without command or permission. The Major visited the school to learn how John was getting on. The master said that he was good and diligent, but regretted to add that he was too much interested in a sort of knowledge which lay apart from his regular studies. He hoped that the father would endeavor to repress these inclinations in his boy. The Major asked the master what they were. The master replied—a love of birds and bugs, shells and stones, in fact, everything that grew, or moved in the air, on the ground, or in the water. If he indulged in such pursuits he would never excel as a mathematician or linguist. "Is my son behindhand then in his studies?" asked the father. "No," replied the master, "he recites well, and is as good a scholar as the best of them; but we wish him to excel all the rest, as he evidently might do if he gave his undivided attention to the studies of his class."

"I am not of that opinion," quoth the Major, with the twinkle in his eye for which he was famous among his cronies—all now dead—"I am not at all of that opinion, and I must request that you will not discourage my son in obtaining a kind of knowledge which I have myself pursued all my life, and which I believe will make all the other kinds of learning which John will get here all the more useful and noble."

The good sense which prompted this request from the side of the father, prompted the master also to grant it, and thenceforward the young naturalist, while being subjected to the same rigid discipline, was not repressed in his inclinations for extra scholastic investigation, on a small scale.

One day silence reigned in the school-room. Everybody was conning his task at his seat. The tutor was silently reading at his desk. Suddenly there was a great fracas—John Le Conte was seen starting from his seat and scrambling on the floor in the middle of the room. He was called up to the tutor's desk to give an account of himself. He held in his hand two beetles. He explained that they were rare, that he could not help trying to catch them, that he had to be quick about it, that he did not know that he would make such a noise, etc. The other scholars in great excitement sat expecting dolorous consequences for John. But they were disappointed. The tutor remembered the Major, or perhaps had received orders from the upper region. He merely sent the boy back to his seat with his beetles, and a warning not to make so much noise another time.

But he received less mercy from his schoolmates. One holiday the boys were on an excursion in Frederick county. John captured two remarkably fine and rare coleopterids—I forget their name, but he always gave it when he told the story—and put them into a pill-box. At night two of his companions stole the box, threw the bugs away, neatly substituted two quids of tobacco, and returned the box to its place without detection. Great was John's grief at the discovery. But he never thought on any kind of revenge. He did not know enough Horace then to comfort himself with the barren consideration, that Quid quisque vitet nunquam homini satis cautum est in horas; but he thought it all the same, in a schoolboy's way, and learned by this experience to keep his shiny-backed pets out of the reach of profane fingers. Dr. Horn can best describe to us the care he took of his great collections.

Le Conte loved to tell such personal stories of his early life, and during the week preceding his death his mind lived entirely in those remote years. He laughed heartily to himself at the recollection of his adventures. He wished to have them published. Why? Was he vain? He was the reverse of vain; he was a man singularly free from vanity. Why should he have had so set a desire to be memorialized after death? I answer without a shade of hesitation, because he had inherited a loving disposition, had led an affectionate and sympathetic life, and wished above all things to retain forever his kind and good relations with his fellow-men. His love of his kind was strong. His sympathy with his fellow-workers in science was not only strong but unalloyed with baser sentiments. Even when his fine scorn of fraud, duplicity, pretension and untruthfulness evoked denunciation, I never knew him to depreciate any kind of talent. He was exceedingly just to just men, and generous towards those who had not had talents or opportunities sufficient to give them distinction. He honored the old and loved the young. He honored the masters and loved the students of science. He worshiped the shade of his father, and never spoke

of himself and his own attainments and accomplishments as anything more than an effort to follow in the footsteps of him who had given him the ability and opportunity to do so.

I dwell principally upon the moral qualities of our departed friend, because I trust that the Society will obtain a complete account of his scientific abilities from Dr. Horn, who has been first his pupil and then his collaborator for twenty odd years. Let us place on our records that memorial of a blameless career in science, and its application to the uses of human existence.

For myself I can only speak of what fills my heart to the exclusion of all other thoughts—of the lovable nature of the friend whom we shall never again see. Let the world reverence his memory as a discoverer, as a philosopher, as a genius. I can only remember John Le Conte as an engaging friend, a faithful friend, a speaker of the truth, a judicious adviser, a companion to think with, a reliable coadjutor to deal with, but still, above all, as a most affectionate and trustworthy friend.

I place above all his other exceptionally shining qualities his affectionateness. He was a lover; and all the world loves a lover. But good lovers are said to be good haters. I doubt the truth of the saying. Selfish lovers may be good haters, but the perfect lover is incapable of any hate that deserves the appellation. Le Conte was one of the men who liked to be called John. He had a regularly woman's heart. And yet he could not hate anybody. When he tried, he simply made himself ridiculous. I have often laughed at his wrath ; it would no more counterfeit real hatred than a crystal of smoky quartz can counterfeit charcoal. His innate lucidity of good nature could not be veiled ; it was as if a cherub knit its brows. And this innate good nature, allying him with the universe, was the salvation of his science, for it protected his mind against those damaging and delaying passions which futilize the career of men of talent, hough their horses and steal the linchpins from their chariot-wheels.

Lovingly he lived and worked many, many years—as many as were good for him. The world wants us all ; and yet needs none of us. It is of no great consequence who is who, or what or how much any one does. What one leaves another takes ; what one begins, some one else is sure to finish. But surely the memory of a friend is blessed, and such a friend as has just left us can never be forgotten.

Memoir of John L. LeConte, M.D. By George H. Horn, M.D.

(Read before the American Philosophical Society, December 7, 1883.)

John Lawrence LeConte was born in New York City, May 13, 1825, and died in Philadelphia, November 15, 1883. He was the son of Major John Eatton LeConte and Mary A. H. Lawrence. When but a few weeks old his mother died, and the father thenceforth seemed to live solely for the

care and development of his only child. The devotion of the father was rewarded in living to see the son take a foremost place among the scientists of his day, honored at home and abroad. The father had already made the name well known in science, when the son entered the field and added greatly to its renown.

After arriving at a suitable age, the boy was placed in St. Mary's College, Maryland, from which he graduated in 1842. From the Doctor's account the discipline of the school was severe, the training accurate and thorough, and the tutors conscientious in the discharge of their duties. At this early period of his life he exhibited the tastes of a naturalist, and he has often recounted the annoyances and ridicule to which he was subjected by his fellow-pupils, who had no sympathy with his pursuits. His teachers, even, feared that his, to them, more important studies would be neglected, and the father was made acquainted with their suspicions. Finding that the pupil was in no respect deficient in his regular duties, the father directed that these tendencies should not be repressed. The boy made rapid progress, and exhibited a peculiar aptitude for the study of languages and mathematics, and, doubtless, in this manner laid the foundation for that accuracy and retentiveness of his memory so characteristic of his maturer years.

After the completion of the collegiate course, he returned to New York, and entered the College of Physicians and Surgeons, receiving his medical degree in 1846. Before this date his first essays in original work made their appearance, and, to use his own language, gave unmistakable evidence of his youth and inexperience.

During 1849 he made several visits to the upper shore of Lake Superior, collecting largely, and publishing the results, with many new species, in Agassiz's work on that region. In the autumn of 1850 he visited California, stopping for a short time at Panama, remaining absent during the greater portion of the following year. His explorations in California were made, for the most part, south of San Francisco, at San José, San Diego and their surroundings. From the latter point he crossed the Colorado desert, then and for many years after a terror to travelers, going as far eastward as the Pima villages. The entire region was a new one to science, and he made abundant use of his opportunities. On his return the results of his journey were published in the "Annals of the Lyceum" of New York. The new material was, however, so abundant that some yet remains in his cabinet unstudied.

In 1852 the LeContes removed to Philadelphia, and the works of both have, with few exceptions, been published in the periodicals of our societies since that time.

For a few months in 1857 he accompanied the Honduras Inter-Oceanic Survey, under the command of the late John C. Trautwine, publishing his observations in that region in the report of the survey. At the same time he visited the Fuente de Sangre, publishing his account of that phenomenon in Squier's Nicaragua.

After these voyages, his scientific studies were uninterrupted until the early years of the war, when he was appointed surgeon of volunteers, and shortly after medical inspector, with the rank of Lieut.-Colonel, in which he showed that his capability for direction and organization was adaptable to wider uses than the cabinet to which he had hitherto confined himself.

During the summer of 1867 he accompanied General W. W. Wright on the survey for the extension of the Union Pacific Railway southward to Fort Craig, in the capacity of geologist. His report, which in no way detracts from his reputation as an entomologist, was published as part of the report of the survey.

In the autumn of 1869 he determined on a visit to Europe, in which he was accompanied by his family, remaining abroad until near the close of 1872, visiting also Algiers and Egypt. His residence abroad interrupted somewhat his authorship, but not his studies, and his letters to me, now doubly valuable, gave abundant evidence of his activity. He visited all the accessible public and private museums, and his wonderful memory of the species in his own cabinet enabled him to settle many hitherto doubtful points of synonymy. Those who met him abroad were deeply impressed by his thorough scholarship, and his quick and accurate perception of the affinities of insects never before seen by him. On his return to Philadelphia his work continued, with but slight interruptions by periods of sickness, until within a week of his death.

The lives of men eminent in science are rarely fertile in events of general interest, and LeConte's is no exception. Trained from his boyhood as a naturalist, with no cares, and no interruptions by daily professional or business duties, his life was passed in the pursuit of his favorite studies and the pleasures of social life. The father died in 1860, leaving the son in possession of an ample estate. The following year Dr. LeConte married Helen, daughter of the late Judge Robert C. Grier, who, with two sons, survives her husband.

The account of the life in science of LeConte should properly begin with that of the father—the one is the result and continuation of the other. An abler pen than mine has already traced the life of the elder LeConte, and I merely purpose to recall such incidents in his life as seem to have a bearing in determining the subsequent studies of the son.

Major LeConte contributed a short entomological paper to the "Annals of the Lyceum," of New York, as early as 1824, describing a few new species, illustrated by a plate drawn by himself. At this time Say and the elder Melsheimer were at the height of their career, and entomology, through the labors of Latrielle in France, was assuming a higher position among the sciences. The Major was an ardent collector, and, desiring the light not attainable at home, much of his material was sent abroad; he, however, retained either carefully compared specimens or drawings to permit the future identification of the species. The cabinet thus formed, small in comparison with what we now have, made the basis of the subsequent work of the son. In 1845 the father and son contributed entomological

papers to the Boston "Journal of Natural History," the former a monograph of Histeridæ, the drawings for which were made by the son, the latter a small paper of little moment.

The first paper by Dr. LeConte appeared in 1844, in the "Proceedings of the Academy of Natural Sciences," having been transmitted by the Entomological Society of Pennsylvania, an association with no permanent locality, consisting of, probably, not more than a half score of enthusiasts, who met at long intervals at the house of one or another. Among the number we find the two Melsheimers, Ziegler and Haldeman, while the Rev. J. G. Morris, D.D., of Baltimore, alone survives to recount their history.

The early papers by LeConte gave very little evidence of his analytical power until, in 1850, he published his "Monograph of Pselaphidæ," proposing an arrangement which remains at present the basis of the general classification of these minute insects. In the same year appeared the commencement of his "Attempt to Classify the Longicorn Coleoptera of America north of Mexico," requiring several years in publication, a work of much wider application than indicated by its title, contributing much that was new to science, and aiding greatly in the rational classification of these favorite beetles.

From this period his contributions to entomology were for the most part monographic, and from their importance soon attracted attention abroad, many of them being reprinted in foreign journals, winning for their author the reputation he justly deserved. In their scope his papers cover nearly every portion of his specialty. They contain evidences of patient and original research, and added greatly to science. His work was in every case an improvement on what had previously been done; he left a subject better than he found it.

Several of his works call for special mention. In 1859 he collected the entomological works of Say, with notes on the species described. In this he was assisted in their specialties by Baron Osten-Sacken and Mr. P. R. Uhler. The writings of Say were widely scattered in almost inaccessible publications, his typical collection almost entirely destroyed, and the species depended practically on traditional knowledge; and while some of Say's cotemporaries were yet living LeConte gathered the information possessed by them, and placed it in permanent form.

Realizing that his specialty needed greater assistance, he undertook, at the request of the Smithsonian Institution, the "Classification of the Coleoptera of North America," with the "List of Species," and descriptions of new ones. The first parts appeared in 1861 and 1862; its continuation was interrupted by the war and his absence abroad. It was resumed in 1873, but never completed. The assistance thus given to students vastly increased their number, and the limited edition soon became exhausted, and it became necessary to decide either for a reprint or a new book.

Before a new edition could be completed, it became imperative to study the Rhynchophora, and at this point LeConte made one of the boldest strokes of his career in the isolation of that series, and purposing a classi-

fication as remarkable in novelty as it was true to nature. This was followed in 1876 by the "Species of Rhynchophora," published as a separate volume of the Proceedings of our Society.

The preliminary studies having been completed, LeConte's desires seemed to be concentrated in the preparation of a new "classification," which should be complete in all its parts. He invited my coöperation in the preparation of monographic essays, hoping thereby to lighten his own labor, and prepare the work in a shorter time. Two years ago, when he realized that his health was failing, he expressed the desire that I should join him in more active authorship in the work. The first pages went to press in January, 1882, and the book was completed in March of this year, in time for him to realize that it has been, at least, well received. For obvious reasons I cannot dwell upon the merits even of his share of this work, except to say that his earlier edition is the basis of the present; without the former the latter might not have appeared. Evidences of his influence will be found on every page, and whatever it was my privilege to contribute was made possible entirely by his early instruction and guidance.

Since last spring he has done but little study, his general health, uncertain vision and unsteady hand having unfitted him for close application. He, however, continued work in the form of "short studies," until within a few days of his death, and the incomplete manuscript now in my hands will appear in the form in which he desired to present it.

While LeConte's reputation as a naturalist will rest upon his entomological writings, he did not limit himself to this field. Mention has already been made of several important geological contributions; there are others of less moment. He has contributed a number of articles on Vertebrate Paleontology, and several synopses of some genera of rodents. His "Zoölogical Notes of a Visit to Panama," illustrate the extent of his study in another department of science. At least one article on purely social science, has emanated from his pen.

In a general review of LeConte's writings, we find them remarkably free from controversial tendencies. He gave to science the results of careful study, knowing that in time whatever was worthy would be adopted. His dissent from the views of another was always couched in the mildest terms. He was above the limit of those petty jealousies which too often prevail between those working in the same field.

Numerous were the demands for his advice and assistance from all parts of the country; rarely did he repel them, and no small portion of his time was consumed in the determination of specimens for correspondents, with no other reward than the hope that the seed thus sown might some day bear fruit.

The results of LeConte's works in Coleopterology in America are plainly marked. He entered the field ten years after the death of Say, who seems to have had no higher ambition, if indeed capacity, than the description of the species which he collected. LeConte, on the other hand, began the

framework of a systematic structure which he lived to see completed in all its parts. He reduced chaos to order. His influence in entomological progress in general is admitted on all hands, and so rapid has been the advance that we now have nearly as many purely entomological societies and clubs as there were interested individuals forty years ago. At that time the American literature consisted of very little beyond the works of Say; to-day five periodicals are devoted solely to entomology.

Some idea of the actual work performed by LeConte may be obtained from a summary recently published, in which more than five hundred genera and nearly five thousand species are placed to his credit, three-fourths in each series remaining valid. It would, however, be unfair to estimate the value of his work from a mere numerical basis; others have done much more, but the systematic, analytical studies, spread over the vast field of Coleopterology, show the real power of his mind. While he was quick to perceive specific differences, he was not always happy in expressing them; in his analyses his reasoning was always clear without the slightest ambiguity.

That his work has been appreciated at home and abroad is shown by the number of societies which have elected him to membership. Diplomas from fifteen American and seventeen European societies may be seen in his portfolio. Prominent among them are the diplomas of honorary membership in the entomological societies of London, France, Berlin, Brussels and Stettin, an honor rarely conferred and given only to the most worthy.

In 1874 LeConte was elected President of the American Association for the Advancement of Science, and his address on retiring, regarding the relation of the geographical distribution of Coleoptera to Paleontology, opened a new line of investigation, showing how a combination of the facts of two such dissimilar sciences might result in advantage to both.

He was one of the founders of the American Entomological Society, and at the time of his death its President; of our own Society he was a Vice-President, and has been a member nearly thirty-one years.

We all knew him as a cultured scholar, a refined gentleman, a genial companion, a true friend. To me he was more. For nearly twenty-five years our association has been of the most intimate nature. I sought his advice and instruction as a neophyte in entomology, finding a welcome which I had no reason to except. Our friendship ripened to an intimacy never shadowed by the slightest cloud. My last visit to him, two days before his fatal attack, will never be forgotten; bright, cheerful and much clearer in mind than he had been for weeks before, he seemed to have regained his mental and bodily strength, and gave me strong hopes that we might for some time enjoy his society. When called to his bedside two days after, the change from brilliant intellection to death-portending coma was almost too great to realize. His life closed painlessly, without a struggle. A few short hours sufficed to extinguish a bright light in science, and inflict on us an irreparable loss.

Dr. Horn testified to the scientific ability, activity and reputation of Dr. LeConte; and Mr. Fraley to his personal worth.

On motion of Mr. Eli K. Price, Dr. Horn was appointed to prepare an obituary notice of Dr. LeConte, and accepted the appointment.

Dr. Brinton reported his reception as delegate of the Society to the Congress of Americanists at Copenhagen, and described the proceedings.

Mr. Phillips, the other delegate, explained that he had been unable to attend the Congress.

General Thayer described the trial balloon which he is building, and explained the principles involved in the problem of of aerial navigation. (See 301.)

Professor Cope described the geological formation and fossil wealth of the valleys and mountains of New Mexico, traversed by him during his recent explorations.

Pending nominations Nos. 985 to 1008 and new nominations Nos. 1009 and 1010 were read.

The minutes of the last meeting of the Board of Officers and members in Council were read.

The Committee of Five reported the following resolution, which was adopted:

Resolved, That hereafter at the stated elections for members of the Society, the presiding member shall appoint two tellers to open the ballot-boxes, and report to him the result of the poll.

On motion of Mr. Law, the following was adopted:

Resolved, That Dr. Brinton be authorized to translate and prepare for publication the Kakchiquil Grammar now in the archives of the Society, and that the same be published in the Proceedings in such type as the Secretary may deem best suited to the purpose.

Mr. Phillips noticed an ambiguity in Sec. 3, Chap. I, of the By-Laws, and Mr. Fraley recounted the traditional interpretation of it by the Society.

The meeting was then adjourned.

Aerial Ships. By Russell Thayer, C.E.

(Read before the American Philosophical Society, Nov. 16, 1883.)

At the close of an interesting paper on the subject of aerial navigation, read before the Institution of Civil Engineers, by Mr. William Pole, F.R.S. M. Inst. C. E., the following conclusions are stated, viz.:

"The problem of aerial navigation by balloons is one as perfectly amenable to mechanical investigation as that of aquatic navigation by floating vessels; and its successful solution involves nothing unreasonable or inconsistent with the teachings of mechanical science.

"It has been fully established by experiment that it is possible to design and construct a balloon which shall possess the conditions necessary for aerial navigation, *i.e.*, which shall have a form of small resistance, shall be stable and easy to manage, and, if driven through the air, shall be capable of steering by a proper obedience to the rudder.

"If, by a power carried with the balloon, surfaces of sufficient area can be made to act against the surrounding air, the reaction will propel the balloon through the air in an opposite direction.

"The modern invention of the screw-propeller furnishes a means of applying power in this way, to effect the propulsion; and the suitability and efficacy of such means have been shown by actual trial.

"Sufficient data exists to enable an approximate estimate to be made of the power necessary to propel such a balloon with any given velocity through the air.

"The recent great reduction in the weight of steam motors has rendered it possible to carry with the balloon an amount of power sufficient to produce moderately high speed, say twenty or thirty miles an hour through the air; and by taking advantage of other recent improvements it would also be possible to carry a moderate supply of fuel and water for the working.

"The practical difficulties in the way are only such as naturally arise in the extension of former successful trials, and such as may reasonably be expected to give way before skill and experience."

In the discussion of the question, Mr. Pole considered the propeller as being the only known available means of utilizing the force generated for the propulsion of the aerial ship; and the deductions above quoted are based upon this means being used to apply the force. My investigations and experiments, however, have induced me to believe that for the purpose desired the propeller is a most clumsy and unsuitable contrivance; indeed, the immense size that would be required for the propulsion of even aerial ships of ordinary dimensions renders its use impracticable.

For the past year I have been making somewhat of a study of this subject, with the object in view of ascertaining whether any practicable method of propulsion could be devised which would enable an aerial ship properly constructed to have a rapid motion through the air, in any direction, entirely independent of the atmosphere or medium in which it floats.

An investigation of the methods heretofore devised to accomplish this object, viz., wheels, propellers, wings, etc., convinced me that all plans so far suggested are quite impracticable; and my experiments led me to the following discovery, based on the well-known law of mechanics that "action and re-action are always equal, contrary and simultaneous."

My invention is simply to make use of the reactive force of a powerful jet of air, gas or vapor, acting rearwards under pressure; thus producing* a re-action forward equal in every respect to the pressure backwards. Under these circumstances the aerial ship will be forced forward at rates of speed depending upon the amount of pressure applied, and it is surprising to note the small pressure required to send a structure of considerable size through the atmosphere at rates of speed varying from ten to fifty miles an hour, without the assistance of the wind, which, under some circumstances, could be most beneficially employed in generating very high rates of motion.

For the following formulæ and values of co-efficients below mentioned, I am indebted to Mr. Pole's paper above referred to; and I have condensed my ideas on the subject in the following memorandum of notes, giving all the salient points of the problem:

Shape.

d = diameter midship section.

e = length of axis.

Shape, cylindrical, pointed at both ends (fore and aft), the best form wherein e = $3\frac{3}{4}$d.

Ascending Force of Gas.

Ad^3l, in which A is a co-efficient, depending on the shape of the vessel and on the specific quantity of the gas compared with that of the surrounding air, may be taken = .03.

The levity of 1 cu. ft. of hydrogen = .0751 lb.

Resistance to Motion through the Air.

$x = .000193\ d^2 v^2$, in which v = velocity in feet per second. The resistance varies as the square of v.

Propelling Force.

The propelling force should act in a horizontal line with all the resistances, which would be a little below the line of the axis (Pole). This force would be produced by air, gas or vapor, acting sternwards under pressure; preferably compressed air, forced through a nozzle suitably connected with a high speed air-compressor.

Machinery Required.

Boiler, steam-engine, air-compressor (receiver), outlet-pipe with nozzle steam condenser, with chemical refrigerating mixture.

* Genl. Thayer has taken out patents for this invention.

To Raise and Lower Ship without using Ballast.

Use an interior air-vessel connected with air-pump, the exterior balloon being connected with a strong light receiver containing hydrogen gas under high pressure. To lower ship, pump air into interior sack and remove hydrogen from exterior balloon. To ascend, remove the air from the interior sack and allow hydrogen to flow into balloon under pressure from receiver; the hydrogen in the receiver would also be utilized to supply loss from leakage.

To Steer Ship.

Use rudder and also a movable nozzle, through which the force of propulsion is applied.

To Elevate or Depress Bow.

Shift ballast or elevate or depress nozzle.

Miscellaneous Data.

In landing, turn the head of the aerial ship to the wind, thus avoiding all danger from dragging, etc. In navigating, it is only necessary to go high enough to clear terrestrial objects.

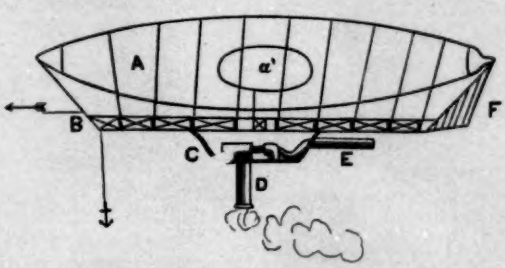
Weight of motor, 40 lbs. per H. P., loss about 15 per cent.

Fuel, 4 lbs. per indicated H. P. per hour.

Water, 28 lbs. per H. P. (condense the steam).

Giffard made envelopes successfully to contain gas with scarcely any loss.

In conclusion, I would say that the general appearance of the aerial ship would be as follows, viz.:



A, balloon; B, upper deck; C, lower deck for machinery; D, smoke-stack; E, nozzle; F, rudder; a', interior air-sack.

Example.

$d = 30'$, $l = 110'$ } Total ascending force $Ad^2l = 2970$ lbs.

Resistance to passing through the air at a speed of twenty miles an hour = 29.33 lin. feet per sec., $.000198\ d^2\ v^4 = 149.5$ lbs.,

a force that can readily be obtained and applied, as I have suggested.

Detailed Section of Chemung Rocks Exposed in the Gulf Brook Gorge at Le Roy, Bradford County, Pennsylvania. By A. T. Lilley, of Le Roy.

(*Read before the American Philosophical Society, December 7, 1883.*)

	Feet.
1. Cap of Chemung with *Atrypas* and many unrecognizable forms in light shale. (*Spirorbis* among them)	1
2. *Productella* bed in gray sand	10
3. Green shale	15
4. Red shale	4
5. Green shale	20
6. *Grammysia* bed and gray shale	25
7. Iron ore, with *Spirifer, Pterinea, Crinoids, Grammysia*, and *fish remains*. (*Spirorbis* among them)	4
8. Green shale	20
9. Red *fucoid* bed	8
10. Green sandstone	20
11. Red shale and sand with unrecognizable fossils	4
12. Conglomerate with pebbles, lime, *Spirifer, Productella* and *fish* remains	6
13. Green shale	10
14. Pink shale	2
15. Green shale	40
16. Green sandstone	2
17. Gray sandstone	19
18. Gray sandstone	1
19. Green shale	52
20. *Strophomena bed*	1
21. Green sandstone	14
22. Green shale	40
23. Brown sandstone, with *Spirifer* and *Productella*	1
24. Gray sandstone, with *Crinoids* and *plants*	8
25. Green shale	6
26. Green sandstone and shale, with *Crinoids* and *Spirifers*	8
27. Gray sandstone and shale	60
28. Green sandstone, with *shells* and *fish remains*	53
29. Red shale and sandstone	14
30. Brown sandstone, with *shells* and *fish remains*	39
31. Green shale	6
32. Red sandstone, with *iron ore* and *shells*	8
33. Gray shale	8
34. *Calcareous iron ore* and sandstone	12
35. Brown shale	20
36. *Calcareous iron ore* (red) and sandstone	11

	Feet.
37. Gray sandstone and shale with carbonized *plant stems*, sulphate of iron and *shells*	2
38. Brown sandstone, with *shells*	10
39. Brownish sandstone, with *Spirorbis* and *shells*	35
40. *Crinoidal limestone*	4
41. Bluish shale	8
42. *Calcareous red sandstone*	9
43. Brown sandstone	18
44. Green sandstone	8
45. *Calcareous sandstone*	4
46. Green sandstone and shale	90
47. *Calcareous sandstone*	5
48. Light gray sandstone and shale	130
49. Gray shale	63
50. *Conglomerate*, with *shells*	3
51. Green shale	12
52. Green sandstone and shale	270
53. *Limestone*, with *shells*	2
54. Gray sandstone and shale, with *shells*	220
55. Gray sandstone, with *fucoids*	1
56. Green sandstone	42
57. Blackish shale, with *Lepidodendra*	50
58. Green and brown sandstone and shale	100
59. Green shale	25
60. *Upper Ambocœlia bed*, with *Loxonema*, *Spirifer*, *Grammysia* and *Bellerophon*	2
61. Unexposed for	70
62. *Lower Ambocœlia bed* in green shale of	50
63. Unexposed to line of Granville township, Bradford county, Pa	50
	1855

Mr. Lilley has made extensive collections of fossils from these rocks, some of which have been studied by Prof. Claypole, of the Second Geological Survey. Recently he has added largely to his number of fish from the Chemung and Lower Catskill rocks; some of the forms seem new.

The Upper Mansfield red beds occasionally contain vast numbers of the plates and scales of fish large and small; he has one perfect scale that measures more than four inches across.

Mr. Lilley has found *Spirorbis* in Nos. 1, 7 and 39 of the section; that is, at intervals of 74′ and 540′ respectively.

He has found a *Holoptychius scale* marked on a rock which contains *tentaculites*, *spirifer*, *ambocœlia*, *pterinea*, and numerous minute shells the species of which he cannot recognize, in the Gulf Brook among the débris of the Mansfield red beds. The rock resembles that of one of the Mansfield red beds outcropping in a small gorge a quarter of a mile west of Gulf Brook, and containing also *tentaculites*, an *orthoceras*, *fish bones*, *crinoids*, and concretionary balls about the size of mustard seed.

PROC. AMER. PHILOS. SOC. XXI. 114. 2M. PRINTED JANUARY 17, 1884.

Stated Meeting, December 7, 1883.

Present, 12 members.

President, Mr. FRALEY, in the Chair.

The resignation of Judge Thayer was received and accepted.

Letters of acknowledgment were read from the Astor Library (XVI, i), the Franklin Institute (XVI, i), the American Statistical Association (113) and the American Ethnological Society (113).

Letters of envoy were received from the Natural History Society at Chemnitz; the Second Geological Survey of Pennsylvania; the Society of Natural Science, at Poughkeepsie; the United States Geological Survey, and Prof. J. J. Stevenson, of the University of the City of New York.

A letter from the S. N. M. S., at Cherbourg, was read, requesting numbers of Proceedings of American Philosophical Society to complete a set.

A letter of inquiry was received from W. F. E. Gurley, dated Danville, Ill., Nov. 30, 1883.

Donations for the Library were reported from Mr. B. S. Lyman, late Chief Geologist of Japan; the German Geological Society; the Anthropological Societies at Vienna and Paris; the Natural History Society at Chemnitz; the Royal Academy at Brussels, and Prof. Paul Albrecht; the Musée Guimet; the Revista Euskara and Revue Politique; the Commercial Geographical Society at Bordeaux; M. Claudio Jannet, of Paris; the Annales des Mines; the Royal Astronomical Society and London Nature; the editor of Cosmos; the Canadian Institute; Littlefield, bookseller, of Boston; the Bunker Hill Monument Association (Hon. R. C. Winthrop); the Boston Natural History Society; Cambridge Museum of Comparative Zoölogy; Harvard University; Essex Institute; American Journal of Science, New Haven; Meteorological Observatory, New York; Vassar Brothers' Institute; Franklin Institute; Dr. D. G. Brin-

ton; American Journal of Pharmacy; Mr. Herbert Welsh; Mr. H. Phillips, Jr.; the Secretary of the Geological Survey of Pennsylvania; the United States Naval Institute; United States Fish and Education Commissioners; United States Geological Survey (C. E. Dutton); H. L. Abbot; S. W. Rauck, of Lexington, Ky.; and the Old Charter of the Hudson's Bay Company, with Arthusen's description, De Boy's and Le France's maps from Prof. J. J. Stevenson.

Dr. Horn read an obituary notice of the late Vice-President, Dr. John L. Le Conte. (See page 294.)

The death of Dr. Charles W. Siemens, at London, Nov. 20, aged sixty-three, was announced by the Secretary.

A section of 1856 feet of Chemung rock at Gulf Brook, Le Roy, Bradford county, Pa., by Mr. Lilley, was read by Mr. Lesley. (See page 304.)

Prof. Cope communicated the following papers:

1. On the distribution of the Loup Fork formation in New Mexico. (See page 308.)

2. A second addition to the knowledge of the Fauna of the Puerco Epoch. (See page 309.)

3. On the Trituberculate type of molar tooth in the Mammalia. (See page 324.)

The Synchronous Multiplex Telegraph invented by Mr. Patrick B. Delaney, of New York, was described by Prof. Houston. (See page 326.)

The Treasurer's annual report was presented.

Pending nominations Nos. 985 to 1010, and new nomination No. 1011 were read.

The Curators were instructed to obtain expert advice from some member of the Society as to the better preservation of the portraits in oil of former officers of the Society.

And the meeting was adjourned.

On the distribution of the Loup Fork formation in New Mexico. By E. D. Cope.

(Read before the American Philosophical Society, December 7, 1883.)

In his report on the Geology of New Mexico to the Secretary of the Interior by Dr. . V. Hayden, in 1869, this eminent geologist described the Santa Fé marls in their principal physical features. In 1874, in my report to Capt. George M. Wheeler, U. S. Engineers, I showed that this formation is a member of the Loup Fork division of the Miocene Tertiary, a conclusion clearly deducible from the remains of vertebrata which it contains. An illustrated report on the latter was published in the fourth volume of the report of the United States Geographical and Geological Survey, W. of the 100th meridian, Capt. G. M. Wheeler in charge (1877).

Since that time the writer has made several visits to part of New Mexico not previously explored, and I am able to show that the Loup Fork formation has a much wider distribution in that Territory than has hitherto been supposed to be the case.

In descending the Rio Grande, beds appear on the west side of the river which strongly resemble those of Santa Fé. They extend along the eastern base of the Magdalene mountains, and as far south as Socorro, in considerable extent and thickness. South of Socorro they appear, but less extensively. The eastern part of the plain which lies between the Rio Grande and the Mimbres mountains is composed of beds of this age where cut by the grade of the Atchison, Topeka and Santa Fé railroad, west of Hatch station. West of the Mimbres mountains the valley of the river of the same name is filled with débris of the bed of eruptive outflow which once covered the country, as far as traversed by the railroad from Deming to Silver City. Its age I could not ascertain.

A great display of the Loup Fork formation is seen in the drainage basins of the heads of the Gila river. In traveling westward from Silver City, its beds first appear in the valley of Mangus creek, which enters the Gila from the east. Crossing the Gila, the mail route to the west passes through the valley of Duck creek, which flows eastwards into that river. Though bounded by eruptive hills and mountains and their outflows, the valley was once filled with Loup Fork beds, which have been extensively eroded, the principal exposures being on the north side of the valley, forming the foot-hills of the Mogollon range. On the divide between the waters of the Gila and San Francisco rivers the formation rises in bluffs of 300 feet elevation. The descent into the valley of the San Francisco brings to light a still greater depth of this deposit. The valley which extends from the cañon which encloses the river south from the mouth of Dry creek to the Tulerosa mountains on the north, and between the Mogollons on the east and the San Francisco range on the west, was once filled with the deposit of a Loup Fork lake. This mass has been reduced by the erosive action of the San Francisco and its drainage, to a greater or less

extent, as it has been protected by basaltic outflows or not. When so protected, the river flows through comparatively narrow cañons. Where the outflow is wanting, the valley of the river is wider, and the Loup Fork formation remains as wide grassy mesas which extend to the feet of the mountain ranges.

The age of these beds would have remained problematical but for the fortunate discovery by Mr. Robert Seip, of the skull of a species of Rhinoceros of the typical Loup Fork genus, Aphelops. It is apparently the *A. fossiger* Cope, a species abundant in the Loup Fork beds of Kansas and Nebraska. It was found near the mouth of Dry creek in a conglomerate bed of the formation.

In the valley of the San Francisco the Loup Fork beds reach a thickness of 500 feet, and consist of sand, clayey sand, soft sandstone, and conglomerates of larger and smaller pebbles of eruptive material, having a near resemblance to those of the region of Santa Fé.

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*Second Addition to the Knowledge of the Puerco Epoch. By E. D. Cope.**

(*Read before the American Philosophical Society, December 7, 1883.*)

Recent collections from the formation above-named, include many finer specimens than have been previously obtained. Skulls of several species in calcareous concretions were received, so that their characters can be developed more fully than heretofore. I mention especially *Deltatherium fundaminis; Periptychus rhabdodon* and *P. coarctatus; Haploconus lineatus; H. entoconus; Anisonchus sectorius; Protogonia plicifera; Mioclænus turgidus, M. ferox, M. subtrigonus* and *M. cuspidatus*, sp. nov. Some species hitherto rarely seen, prove to be abundant, as *Hemithlæus kowalevskianus, Protogonia plicifera, Mioclænus minimus* and *M. subtrigonus*. With the additional species now described, the number of Mammalia from the deposit of the Puerco epoch amounts to seventy-four species.

DIDYMICTIS PRIMUS, sp. nov.

That the genus Didymictis existed during the Puerco epoch, has been already demonstrated by the discovery of the *D. haydenianus* Cope. This species is of aberrant form however, so that it remained to prove that the typical form had appeared so early in Tertiary time. This is now shown to have been the case by the discovery of the present animal, which is allied to the *D. leptomylus* of the Wind River and Wasatch epochs.

The *Didymictis primus* is known from two maxillary bones with teeth,

*The "First Addition" appeared in the Proceedings of the American Philosophical Society for 1883, beginning at page 545. Since that date I have described in the Proceedings of the Philadelphia Academy, 1883, p. 168, the following species: *Periptychus coarctatus, Pantolambda cavirictus, Zetodon gracilis* (g. n.) and *Conorycles ditrigonus*.

and a part of a mandibular bone with the last two molars in place, all belonging to different individuals. The inferior sectorial tooth is much like that of the *D. leptomylus*, but the tubercular is only two-thirds as long, and is not only absolutely, but relatively narrower posteriorly. It has the usual three cusps in a reduced condition. In the first superior true molar the external cusps are conical, and there is a small cusp between the anterior one and the produced anterior angle of the crown. There is an anterior intermediate tubercle, but no posterior one. The cingulum does not extend all round the inferior base of the crown, as it does in *D. protenus*. The sectorial has a distinct anterior basal conic lobe. The internal lobe is in transverse line with the last named, and is conical and not large.

Measurements.		M.
Diameter inferior sectorial	anteroposterior	.0138
	transverse	.0055
Diameter inferior tubercular	anteroposterior	.0050
	transverse	.0033
Depth of ramus at M. i		.0098
Diameter superior sectorial (No. 1)	anteroposterior	.0110
	transverse	.0060
Diameters superior sectorial (No. 2)	anteroposterior	0050
	transverse	.0090

The fourth specimen is especially important as presenting almost the entire dentition including canines and incisors, and the anterior part of the skull from the line of the coronoid process of the mandible. The specimen shows that the species differs from the species of the Wasatch period with oval inferior tubercular, in the absence of the posterior cutting lobe of the third, and probably fourth inferior premolar. The corresponding superior premolars are also simple. The first premolars in both jaws are one-rooted. The canines are long and acute, and are directed vertically. Both have flat facets on their external (the only visible) faces: on the superior canine I count four lateral, and one nearly anterior. On the inferior I see three lateral and one nearly anterior. There are three small superior incisors, of which the first is the largest, and has a subconical crown. The infraorbital foramen is large, and is above the anterior border of the superior sectorial.

Measurements.	M.
Length of superior dental series to front of canine	.041
" " crown of superior canine	011
" " superior true molars	.0105
Depth of ramus at inferior sectorial	.0090

In its simple premolars this species agrees with the *D. haydenianus*, and is more primitive than the Wasatch species.

TRIISODON RUSTICUS, sp. nov.

Founded on a portion of the mandible which supports the first two true molars and part of the last premolar. The species is of the type of *T.*

levisanus, but is much larger. I give here a synopsis of the species of the genus, so that its affinities may be better understood. In general, the genus *Triïsodon* is characterized by the rudimental character in the inferior molars of the anterior cusp. It is thus like *Ictops*, but differs in having the fourth premolar different from the true molars and like the premolars. From *Mioclænus* it differs in having the anterior and posterior cusps of the inferior molars unequal; the anterior forming together an elevated crest with two apices, while the posterior are low, and on the borders of a heel.

I. Cusps of inferior molars compressed.

Anterior cusp very low..... *T. quivirensis.*

II. Cusps of inferior molars not compressed.

Anterior cusp very low; *T. rusticus; T. levisanus*, and *T. assurgens.*

Anterior cusp as high as other anterior cusps to which it is closely united. *T. conidens* and *T. heilprinianus.*

In dimensions the *T. rusticus* is about equal to the *T. quivirensis*, thus exceeding the other species excepting the *T. conidens*. The interior anterior cusp is nearly as elevated as the exterior, and is united with it nearly to the apex; the anterior cusp is a tubercle which projects forwards from its anterior base. The heel of the tooth is wide, and is rounded posteriorly, and supports three tubercles, an external, a posterior and an internal, all in contact with each other. On the second true molar the internal anterior tubercle presents a slightly projecting edge anteriorly and posteriorly, which bounds a shallow vertical groove of the mass which represents their united bodies. This is not apparent in the first. The enamel is smooth, but the animal is rather old.

Measurements.			M.
Diameters of m. i	anteroposterior		.0123
	transverse		.0068
	vertical	in front	.0068
		at heel	.0038
Diameters of m. ii	anteroposterior		.0137
	transverse		.007
	vertical	anteriorly	.007
		at heel	.0062

D. Baldwin, discoverer.

TRIÏSODON ASSURGENS, sp. nov.

This is the least species of the genus, and resembles in its inferior dentition the species of *Diacodon*. It is very much larger than the *D. alticuspis*, the larger species of that genus, which is found in the Wasatch formation.

The *T. assurgens* is known from a mandibular ramus which supports the last four molars, the last premolar having lost its principal cusp. The peculiarity of the true molars is seen in their generally more produced character; the anterior cusps are higher and the heels are longer. The anterior cusp is very small and basal; the principal anterior cusps are united

to near their free summits. There are the usual low marginal tubercles on the heels. That of the fourth premolar is a short simple edge.

Measurements.	M.
Length of four molars on basis	.028
" " three true molars	.0212
" " second true molar	.008
Elevation of cusps of molars	.0045
Length of last true molar	.0067
Width of last true molar	.0030
Elevation of last true molar in front	.0035

Found by D. Baldwin.

MIOCLÆNUS CUSPIDATUS, sp. nov.

The species of this genus known to me are, with the present one, nine in number. They range in size from that of a rat (*M. minimus*) to that of a wolf (*M. ferox*). The general osteological characters of the last named species are best known, and are described in the Proceedings of the American Philosophical Society, 1883, p. 547. In two of the species the superior dental series only is more or less known, and one species rests on mandibular dentition only. In the remaining seven species the dentition of both jaws is more or less known. The species may be arranged in groups as follows:

I. The posterior heel of the second inferior molar bordered by a curved edge or crest.

a. Posterior cingulum of superior true molars obsolete; *M. minimus*.

aa. Posterior superior cingulum weak; *M. turgidus*.

aaa. Posterior superior cingulum large, angulate; *M. corrugatus*; *M. ferox*.

II. The posterior heel of the second inferior molar supporting a cusp.

á. Posterior inner cusp of superior molars small, present on m. ii only; *M. cuspidatus*.

aa. Posterior inner cusp large, present on m. i and m. ii; premolars small, *M. subtrigonus*; premolars large, *M. opisthacus* (*Hemithlæus mihi olim*).

III. Second lower molar unknown. *M. protogonioides*, and *M. mandibularis*.

The supposed *M. baldwini*, resembles closely the species of *Hemithlæus*.

It is probable that two genera are here included under the head of *Mioclænus*. If the character is permanent, these will be distinguished as follows:

Third superior premolar with internal tubercle.....*Mioclænus*.
Third superior premolar without internal tubercle.....*Oxyclænus*.

The species of *Mioclænus* are *M. turgidus* (type); and very probably *M. opisthacus*, *minimus* and *M. subtrigonus*; but the diagnostic tooth has not been seen in them as yet. The species of *Oxyclænus* are: *O. cuspidatus*

and *O. corrugatus*; and very probably, *O. ferox*. The position of the *M. protogonioides*, *M. baldwini* and *M. mandibularis* is uncertain, though the last two are probably *Ozyclæni*.

The *Mioclænus cuspidatus* is distinguished among its congeners, by the transverse character of its superior molar teeth, that is, by the relatively smaller anteroposterior diameter as compared with the transverse; and by the prominence and acuteness of their principal cusps. They thus stand at the opposite extreme of the genus from the *M. turgidus*, where the teeth are characterized by the robustness and obtuseness of the cusps, although in the triangular basis of the second superior molar they agree. The external cusps are compressed cones, and in contact at the base; the intermediate tubercles are small and distinct. The internal cusp is large and prominent. The base of the fourth premolar is T-shaped, and is as long as wide. Its internal and external cusps are well developed. The cingulum of the true molars is complete all round on the last one, and on the two others except at the internal base, where it is interrupted. The second molar only displays a posterior inner tubercle of the cingulum, which is small, and does not give a truncate interior outline of the crown, characteristic of *M. opisthacus*, *M. ferox*, etc. On the ms. i and ii, the cingulum is expanded at the external angles of the crown, most so anteriorly. The anterior expansion rises in a low cusp in the P-m. iv. The enamel is smooth.

This species need only be compared with *M. opisthacus* and *M. subtrigonus*, which are of about the same size. Passing by the differences already mentioned in the table, the fourth premolar has a different form from that of the *M opisthacus*. In the latter it is narrower and more transverse, and with larger conical cusps, much as in *M. turgidus*; in the present species it has the trilobate outline seen in *M. subtrigonus*. As to the latter species, the teeth are wide, and the cusps smaller and separated at the base, and the cingulum is crenate and lobate, in a manner quite different from the smoothness and compactness of structure seen in the *M. cuspidatus*.

Measurements.		M.
Length of base of last four superior molars		.026
" " " three true molars		.019
Diameters of P-m. iv	anteroposterior	.006
	transverse	.004
Diameters of m. i.	anteroposterior	.006
	transverse	.006
Diameters of m. ii	anteroposterior	0064
	transverse	008
Diameters of m. iii	anteroposterior	.0045
	transverse	.006

D. Baldwin, discoverer.

CHRIACUS TRUNCATUS, sp. nov.

The genus *Chriacus* m. was characterized in the Proceedings of the

Academy of Philadelphia, 1883, p. 80, and two species were mentioned, *C. pelvidens* (type) and *C. angulatus*. The former of these is from the Puerco, the latter from the Wasatch formation; the former is the larger species; the latter quite small. I now add two species to the genus which are intermediate in dimensions between those already known.

I. Posterior cingulum of superior molars with large tubercle.

Large species; *C. pelvidens;* small species, *C. truncatus.*

II. Posterior cingulum with small tubercle; small species; *C. angulatus.*

III. Posterior cingulum without tubercle; small species; *C. simplex.*

In the *C. truncatus* the posterior singular (inner) tubercle reaches the largest development, but is not present on the cingulum of the last superior molar. The anterior cingulum is weak on that tooth and on the first true molar, but on the second it is thickened into a small anterior or inner tubercle. This, with the posterior inner, gives the crown a truncate internal outline, as is also the case in the *C. pelvidens.* The intermediate tubercles are distinct, and the external cusps are separate at the base. An external cingulum. The fourth premolar has a triangular base; a single compressed external cusp, and a small acutely conical internal one. The internal tubercle is small and acute on the third premolar. The second premolar is small and probably one-rooted, and it is possible that there is no first premolar. The canine is directed vertically downwards, and the base of the crown is oval.

Besides the considerably smaller size, the posterior internal cusps are relatively larger than in *C. pelvidens.*

Measurements.		M.
Length of superior dental series including canine		.039
Length of true molar series		.014
Diameters P-m. iii	anteroposterior	.004
	transverse	.003
Diameters P-m. iv	anteroposterior	.004
	transverse	.005
Diameters M. ii	anteroposterior	.005
	transverse	.0064
Diameters m. iii	anteroposterior	.0033
	transverse	.005

Two individuals from New Mexico. D. Baldwin.

CHRIACUS SIMPLEX, sp. nov.

This species is represented by a part of the left maxillary bone, which supports the true molars except a part of the last one; and by parts of the mandible, with the first and second true molars, and perhaps one of the premolars. The true molars are about the size of those of the *C. truncatus,* but of very different detailed structure, as already pointed out. The posterior cingulum is stronger than the anterior, but does not support a trace of a cusp, and they do not unite on the inner face of the crown. External

cingulum present. External cusps rather small, separate. Intermediate cusps present; V large and distinct. Enamel smooth.

The inferior true molars support Vs; in the second the anterior is smaller and is more elevated than the posterior. The latter is continued as a raised posterior, and partly interior border of the heel, without prominent cusp. The crown has a distinct external and a very faint internal cingulum. In the supposed first true molar, the anterior V is more prolonged anteroposteriorly as in the corresponding tooth of *Mioclænus ferox*, etc., and the fourth premolar of *Phenacodus primævus*. The anterior cusp is the lowest. The heel supports three low cusps, of which the external has a crescentic section, and the posterior is the smallest.

It is probable but not certain that the fourth premolar has an internal cusp, as the tooth, presumably this one, is injured at that point, Should the internal cusp be absent, this species cannot be referred to *Chriacus*.

Measurements.		M.
Length of superior true molars		.0135
Diameters of first true molars	anteroposterior	.005
	transverse	.006
Diameters of second true molars	anteroposterior	.0053
	transverse	.007
Diameters of third true molar	anteroposterior	.0034
	transverse	.006
Diameters of first inferior true molar	anteroposterior	.005
	transverse	.0035
Diameters of second inferior true molar	anteroposterior	.0056
	transverse	.0043

D. Baldwin, discoverer.

TRICENTES CRASSICOLLIDENS, gen. et sp. nov.

Char. gen. This genus is *Chriacus* with only three premolars in the superior, and probably inferior series. The canines are well developed, and lateral in position, leaving space for small incisors, thus differing from the genera of the *Mixodectidæ*, *Mixodectes*, *Microsyops*, and *Cynodontomys*, on the one hand, and from *Necrolemur* on the other. It has, so far as known, the dental formula of several genera of typical Lemuridæ, but differs from these in the following points. The orbit is open posteriorly; the inferior molars have the anterior triangle of three cusps; and the fourth inferior premolar has an interior cusp. I have demonstrated the last mentioned characters on the type, *T. crassicollidens* only, but suspect its presence on some or all of the other species. In their details the superior true molars are like those of Mioclænus, as distinguished from those of Pelycodus.

To this genus belongs the *Mioclænus subtrigonus*, and probably, from the small size of its fourth premolar, the *M. bucculentus*. I add to these three a fourth, *T. inæquidens*, and remark that it is yet uncertain how many premolars are present in the *Chriacus simplex*. Should the latter possess three only, it will be properly referred to Tricentes.

These species differ as follows:

I. Posterior cingulum of true molars i and ii, wide, rising into a small cusp.

Length of true molars, M. .0155.....*crassicollidens.*

II. Posterior cingulum distinct, thickened inwards.

Length of true molars (m. ii inferential) .0175, crowns narrowed, transverse.....*bucculentus.*

Length of true molars .0170; crowns quadrate.....*subtrigonus.**

Length of true molars .0135; crowns narrowed, transverse.....(*Chriacus*) *simplex.*

III. Posterior cingulum weak, disappearing inwards.

Length of true molars .0105, crowns transverse except the third, which is very small.....*inæquidens.*

Char. Specif. The *Tricentes crassicollidens* is about the size of the *Chriacus truncatus* and resembles it a good deal. The latter has, however, a more transverse form of true molars, as compared with the present species, where the form is subquadrate. In the present animal the premolars are smaller, and if the third (second present) has an internal cusp, it is much more insignificant than in the *C. truncatus*. These two species and the *Mioclænus opisthacus* resemble each other in the similar size, and in the true molars having the posterior inner cusp more distinct than in other species. They differ in the dimensions of their premolars, those of the *M. opisthacus* being the largest, and those of *C. truncatus* being intermediate in size. In the *T. crassicollidens* the anterior cingulum is also distinct. The external cusps are conic, and are well separated, and the internal V is distinct. The internal cusp of the fourth premolar is small and compressed, so as to be transverse. The base of the third premolar is triangular and much longer than wide. All the superior molars, except the first premolar, are furnished with an external cingulum, which rises into a more or less distinct apex at its anterior and posterior angles. The first premolar is a simple cone. The alveolus of the canine tooth is of large size. The last true molar is not much reduced, and the first is as large as the second. This is not the case with the *T. bucculentus*, where the first is considerably smaller than the second.

Measurements.	M.
Length of dental series to canine, exclusive	.036
" " diastema	.006
" " premolar series	.0143
" " true molar series	.0152
Diameter of P-m. iv anteroposterior	.0042
Diameter of P-m. iv transverse	.0042

*There may be two species confounded under this name. A specimen figured in Vol. III of the final (4to) Report of the Hayden Survey, Plate XXIV, *f*, fig. 4, has four interior premolars, all simple.

Measurements.		M.
Diameter of M. i	anteroposterior	.0058
	transverse	.0050
Diameter of M. iii	anteroposterior	.0030
	transverse	.0048

A pair of mandibular rami, found on the same day, and at or near the same place, probably belong to the same species, if not to the same animal, they support all the teeth, but only the P-m iv and the M. i and ii have yet been disengaged from the matrix. The P-m. iv is rather large and robust, and has a short wide heel, and an anterior cusp which leaves the main cusps half way to the apex, or at the same elevation as the internal cusp. The anterior three cusps of the true molars are elevated above the heel, and the anterior is nearly median, forms no blade with external anterior, and is smaller than the anterior internal cusp. The heel is well developed, and its borders rise in two obtuse open Vs, whose apices look away from each other. The internal supports two cusps, the external, but one. No cingula; enamel smooth.

Measurements of inferior teeth.		M.
Diameters of P-m. iv	anteroposterior	.0060
	transverse	.0035
Diameters of m. ii	anteroposterior	.0050
	transverse	.0039
Length of bases of m. i and m. ii		.0110

From Upper Puerco; D. Baldwin.

TRICENTES INÆQUIDENS, sp. nov.

This species is represented by two mutilated crania, obtained on the same day and near the same locality as the preceding species. One of these, which I select as type, embraces the muzzle and palate anterior to the posterior border of the maxillary bone.

Besides its inferior size, other characters distinguish this species. The simplicity of the superior molars is seen in no other, and the very reduced size of the third superior molar is not found in any of its allies. This is correlated with an oblique reduction of the maxillary bone behind, which gives the second true molar an oblique external border instead of the longitudinal one seen in the other species. The external cusps of the molars are conic, and are not in contact at the base. The internal cusp is also conic, and is larger than the external. The internal cusp of the fourth premolar is large. It is probable that the third premolar supports an internal cusp, as the crown base is as wide as long. The premolars are spaced in this species, as in the last, but the diastema is shorter than in the *T. crassicollidens*, not exceeding the premolar interspaces. The external cingulum is quite weak. The canine alveolus is large. The incisors are wanting, but the premaxillary region is wide. The inferior dentition is unknown.

Measurements of superior teeth.	M.
Length of dental series, including canine	.0272
" from canine to m. i, exclusive	.0130
Length of true molar series	.0100
Diameter of P-m. iii { anteroposterior	.0028
Diameter of P-m. iii { transverse	.0025
Diameters of P-m. iv { anteroposterior	.0030
Diameters of P-m. iv { transverse	.0042
Diameters M. i { anteroposterior	.0038
Diameters M. i { transverse	.0048
Diameters M. ii { anteroposterior	.0039
Diameters M. ii { transverse	.0059
Diameters M. iii { anteroposterior	.0015
Diameters M. iii { transverse	.0024

Upper Puerco; D. Baldwin.

INDRODON MALARIS, gen. et sp. nov.

Char. gen. Family Anaptomorphidæ, suborder perhaps Lemuroidea, as indicated by the dentition only. It differs from *Anaptomorphus* in three points. First, there are three superior incisors; second, the first (third) premolar has no internal lobe; and third, there is a distinct posterior internal tubercle on the first and second superior molars.

The animals of the Eocene period of the family of the *Adapidæ*, may belong to the *Lemuroidea*, but the evidence which I have derived from the feet of *Polycodus** has led me to refer them† to the Insectivorous division of the Bunotheria, to the neighborhood of the Tupæidæ and Erinaceidæ. At the same time I retained provisionally the genera with three and two superior premolars in the suborder Lemuroidea, although the foot structure of these extinct genera is yet unknown. I also indadvertently defined the Lemuroidea as having quadrituberculate superior molars, a character which I well knew to be wanting in various extinct and recent genera where they are tritubercular. Two families were proposed† for the Eocene lemuroids, which are defined as follows:

Superior premolars three ..... *Mixodectidæ.*
" " two ..... *Anaptomorphidæ.*

The genera of the first named family are defined as follows:

I. Canine teeth large and lateral, well separated.
First superior premolar without internal lobe; superior true molars tritubercular with cingula ..... *Tricentes.*

II. Canine teeth median in position or much reduced in size.
a. Last inferior premolar without internal tubercle.
Inferior premolars all one-rooted; canine and incisor small.. *Necrolemur.*‡

* Report of U. S. G. G. Survey W. of 100th Mer., G. M. Wheeler, Iv, p. 140.
† Proceedings Academy Natural Sciences of Philadelphia, 1883, p. 78-80.
‡ Filhol Rech. Phosph. Quercy.

First premolars only one-rooted ; canine small ; incisor very large.....*Mixodectes.**

aa, Last inferior premolar with internal tubercle.

A very large ? canine ; first premolar only, one-rooted.....*Microsyops.*†

A very large ? canine ; first and second premolars both one-rooted.....*Cynodontomys.*‡

The genera of Anaptomorphidæ, which on dental characters includes *Indrodon*, differ as follows :

a. Incisors three.

First superior incisor without inner lobe ; posterior inner tubercle present on first and second tubercle.....*Indrodon.*

aa. Incisors two.

First superior incisor with inner lobe ; no posterior inner tubercle on superior molars .....*Anaptomorphus.*

The superior dental formula of *Indrodon* is I. $\frac{3}{3}$; C. $\frac{1}{1}$; P-m. $\frac{2}{2}$; M. $\frac{3}{3}$. The canine is compressed and acute ; the third premolar is compressed conic, and has two roots. The fourth premolar has but one external cusp. The external cusps of the true molars are conic and acute, and are connected with the internal cusp by ridges which form a V. Posterior inner cusp distinct on ms. i and ii, a part of the posterior cingulum. Intermediate tubercles present, small. The superior incisors are well developed, and display no tendency towards the rodent type. A portion of lower jaw adheres to the skull, and may belong to the same animal. It supports the last two molars. These have two anterior, opposite, approximated cusps. The heel of the penultimate molar is rather large, and has a raised edge, which develops low tubercles at the angles.

Char. Specif. The first and third superior incisors are a little larger than the second. Canine preceded and followed by diastemata, each of which is 1.5 times as long as the long diameter of the base of the crown. Premolars separated from each other and from the first true molar by interspaces half as long as the diastema. Neither tooth has any basal tubercles, but the posterior has a weak external cingulum, which is stronger posteriorly. The internal cusp of the same tooth is anterior, is acute and elevated. The superior true molars have a strong external cingulum, which rises into a small tubercle opposite the space between the external principal cusps. Of the latter, the anterior is a little more conic than the posterior, and both are well within the external border. On the last molar, the posterior external cusp is continuous with the external intermediate tubercle, and forms a cutting edge within the posterior margin of the crown. The posterior inner tubercle is rather large, and projects further inwards than the apex of the anterior V on the second true molar, but not so far as in the species of *Anisonchus* and *Haploconus*.

* Proceedings American Philosophical Society, 1883, p. 559.

† Leidy Report U. S. Geol. Survey, Terrs. I.

‡ Cope, Pal. Bull. No. 34.

The surface of the cranium is too much obscured by cracks and films of matrix to permit a view of the sutures and foramina. The face is wide, as the posterior part of the maxillary and the malar bone are expanded outwards. I have not yet been able to ascertain the condition of the orbit posteriorly. The mandibular ramus is rather slender.

Measurements.	M.
Length of dental series from posterior base of i iii.	.0248
" " bases of superior incisors.	.0060
" from i iii to P-m. iii, exclusive.	.0074
" of premolars on maxillary bone.	.0060
" " base of P-m. iii	.0020
" " P-m. iv.	.0028
Width " "	.0038
Diameters m. i { anteroposterior	.0030
Diameters m. i { transverse	.0032
Diameters m. ii { anteroposterior	.0033
Diameters m. ii { transverse	.0040
Diameters m. iii { anteroposterior	.0030
Diameters m. iii { transverse	.0040
Diameters inferior m. ii { anteroposterior	.0032
Diameters inferior m. ii { transverse	.0030
Depth of ramus mandibuli at m. ii.	.0070

The skull is about the size of that of the *Bassaris astuta*. D. Baldwin, discoverer.

The discovery of this type in the Puerco formation is a fact of interest. In the shortening of its dental series it is the most specialized genus of the epoch, while the forms of its true molars are like those of the simpler Creodonta, and more specialized than those of *Anaptomorphus*, and the lemurs generally. In the simplicity of its premolars, however, it maintains the general character of the Puerco fauna, and is more primitive than the forms just named. Its nearest ally of the Puerco yet known is *Chriacus*.

ANISONCHUS AGAPETILLUS, sp. nov.

This species is founded on parts of six mandibular rami, none of which has more than four continuous molars in position, including the last. It is not entirely certain that these belong to a species of *Anisonchus*, because the superior molar teeth by which that genus is distinguished from *Haploconus* and *Hemithlæus*, are wanting. The inferior molars have the anterior inner cusp moderately well developed, as in *Anisonchus gillianus*.

The crowns of the true molars consist of two Vs; of which the posterior base of the posterior one, is rendered irregular by the presence of a small posterior median tubercle. Of the anterior pair of cusps, the external is a little the more elevated, and the internal is more elevated than any of the posterior ones. The internal posterior as well as the external posterior

cusp has a V-shaped section, because its anterior border is continued as an oblique ridge to the base of the anterior internal cusp. Internal cingular none; a slight one on the external base of the large anterior external cusp. The heel of the third true molar is well developed, and rises into an acute cusp. That of the fourth premolar is short and flat. The anterior cusp of the same is basal and rudimental. This tooth is not enlarged as is usually the case in the *Periptychidæ*, and it first here differs from these animals, and agrees with the unguiculate types in that its lateral faces are unequally convex.

Measurements.	M.
Length of last four molars on base	.014
" " fourth premolar	.0035
Elevation of " "	.0038
Length of second true molar	.0031
Width " " " (greatest)	.003
Length of third " " "	.004
Width " " " "	.0028
Depth of ramus at second true molar	.007

ANISONCHUS COPHATER, sp. nov.

A mandibular ramus supporting three molars, two of them true, is all that I have seen of this species. Its proportions are the same as those of the *A. agapetillus*, that is, much smaller than the *A. gillianus*, and the single premolar is much more like that of other species of the genus. The true molars differ from those of the *A. agapetillus* in two strong characters. First, the internal posterior cusp is inside the rim of the heel of the crown, that is, outside the bordering edge, and is therefore very distinct from the posterior median cusp. It is a sharp cone; secondly, there is a cingulum extending from this cusp round the internal base of the internal anterior cusp. There is also one at the base of the external anterior cusp, which continues to the heel only on the last inferior molar. The posterior heel is relatively wider, and the anterior V relatively more contracted, than in the *A. agapetillus*. The anterior tubercle is moderately developed at the anterior base of the anterior V. The third or fourth premolar is equilateral, and larger than the true molars. It has a short apiculate heel, and a rudimental anterior basal tubercle.

Measurements.			M.
Diameters of m. ii	horizontal	anteroposterior	.0032
		transverse	.0030
	vertical	anterior	.0025
		posterior	.0013
Diameters of P-m. iii or iv		anteroposterior	.0043
		vertical (restored apex)	.0040
		transverse	.0023

D. Baldwin, discoverer.

CHIROX PLICATUS, gen. et sp. nov.

Char. gen. These are known from three superior molars; viz: the last

premolar, and the second and third true molars. The fourth premolar has two external, and one internal cusps, and the true molars have four cusps each. The cusps are of peculiar form. The second true molar resembles a convex body which has been divided by two cuts at right angles to each other, from which the quarters thus produced have spread away from each other subequally. The external faces of the cusps are convex. The apices are acute. The last superior molar is larger anteroposteriorly than transversely. The fourth premolar (supposed) is two-rooted.

These molar teeth remind one of the inferior molars of *Ptilodus*, through they differ much from them. The genus is probably nearer to *Catopsalis*, and belongs to the Marsupial order. The presence of only two series of cusps in the superior molars, distinguishes it from these genera, which have presumably three series of such cusps. Lemoine has shown this to be the case in *Neoplagiaulax*.

Char. specif. The external cusps of the fourth premolar are flattened on the external side, and lean a little inwards. The internal cusp (probably homologically the anterior) is opposite the anterior external, and has a convex internal face. Its apex is acute and compressed; the apices of the external cusps are trihedral and acute.

The cusps of the second true molars are more widely separated transversely than anteroposteriorly; that is, the longitudinal fissure is wider than the transverse. The apices are all acute, the internal trihedral, the external more compressed.

The transverse diameter of the last true molar is smaller than that of the second true molar, while the longitudinal is nearly the same. The crown projects convexly posterior to the posterior pair, and there is a small tubercle at the anterior base of the external anterior cusp.

None of the teeth preserved display cingula. The bases of the crown are smooth, but the cusps are sharply and finely parallel-grooved on their external faces.

Measurements.		M.
Diameters of P-m. iv	anteroposterior	.0030
	transverse	.0038
Diameters of m. ii	anteroposterior	.0033
	transverse	.0035
Diameters of m. iii	anteroposterior	.0035
	transverse	.0030

D. Baldwin, discoverer.

CATOPSALIS FISSIDENS, sp. nov.

This Marsupial is represented by a portion of the lower jaw which supports the molar teeth. The first, which is probably the fourth premolar, is represented only by its single root, which fills a round alveolus near the anterior base of the first true molar.

In size this species is intermediate between the small *C. foliatus* and the large *C. pollux*. The first molar is the longer and narrower, and the

second the shorter and wider, as in the known species. The first molar differs from that of both the latter, in having the tubercles of one side separated nearly to the base. These tubercles are conic, and not flattened as in *C. foliatus* and *C. pollux*, and the two rows are separated by a distinct valley, as in the first named. There are five tubercles on one side, and four on the other side of the crown, and in addition, two small cusps at the anterior extremity of each row, and another at the posterior extremity of one of the rows. These additional cusplets are not present in the other species.

The last molar is relatively wider than in the other species. Its crown is a good deal worn, but there are probably more than two rows of tubercles, as there are some appendicular rows on one side of the crown at least.

Measurements.		M.
Diameters M. i	anteroposterior	.0135
	transverse	.0050
Diameters M. ii	anteroposterior	.0090
	transverse	.0075

The Upper Puerco; D. Baldwin.

General remarks on the characters of the Mammalia of the Puerco Epoch.

I have already called attention to the fact that the Mammalia of the Puerco epoch possess, with but few exceptions, superior molar teeth whose crowns include only three of the component tubercles of the normal mammalian molar, in a condition of full development.* In the number of species of supposed placentals now known, sixty-seven, the proportion of species (1), with quadrituberculate superior molars is even smaller, being only four to sixty-three. The premolars display equally primitive characters, and to these I wish now to draw attention.

2. The presence of two internal tubercles of the fourth superior premolar is unknown as yet in the fauna.

3. The presence of two external cusps of the same tooth is known or inferred in only five species in the sixty-seven, and in two of the five it is of reduced size.

4. The presence of one internal cusp of the fourth superior premolar is demonstrated or inferred in all of the placental species.

5. The presence of the internal cusp of the third superior premolar is, on the other hand, only demonstrated in twenty-two species. In seventeen it is wanting.

Referring to the inferior premolars:

6. No species presents an internal cusp of the third premolar.

7. An internal cusp of the fourth premolar is present in only fourteen species. In twenty-nine species it is certainly wanting.

* Proceedings of the American Philosophical Society, 1883, 562. American Naturalist, 1883, 407.

8. In no species of this formation is the fourth inferior premolar like a molar tooth.

It is thus evident that the dentition of the mammalia of the Puerco fauna presents a much greater degree of simplicity than does that of the species of any of the later Eocene or other age. This result coincides with the results I have already obtained from a study of the structure of the feet, etc.* These may be summarized again as follows:

1. The species in which the number of toes is known, have them 5–5.
2. Those in which the feet are known are plantigrade.
3. No species is known to have interlocking carpal and tarsal bones, excepting the two species of *Pantolambda* (carpus unknown).
4. No species is known to have well grooved astragalus (its presence is inferred in two species of *Dissacus*).
5. No species is known to have a faceted radius or ulno-radius, adapted to the separate carpal bones of the proximal row.
6. In no species is the tongue in the metapodio-phalangeal joints developed on the front of the metapodial bones.
7. The zygapophyses where known are all flat, except in some species (probably all) of *Oxyclænus*, where they are simply convex-concave, and not doubly so.

On the Trituberculate Type of Molar Tooth in the Mammalia. By E. D. Cope.

(*Read before the American Philosophical Society, December 7, 1883.*)

It is now apparent that the type of superior molar tooth which predominated during the Puerco epoch was triangular or tritubercular; that is, with two external and one internal tubercles.† Thus, of sixty-seven species of placental mammalia of which the superior molars are known, all but four have three tubercles of the crown, and of the remaining sixty-five, all are triangular, excepting those of three species of Periptychus, and three of Conoryctes, which have a small supplementary lobe on each side of the median principal inner tubercle.

This fact is important as indicating the mode of development of the various types of superior molar teeth, on which we have not heretofore had clear light. In the first place, this type of molar exists to-day only in the insectivorous and carnivorous Marsupialia; in the Creodonta, and the tubercular molars of such Carnivora as possess them (excepting the plantigrades). In the Ungulates its persistence is to be found in the molars of the Coryphodontidæ of the Wasatch, and Dinocerata of the Bridger Eocenes. In later epochs it is occasionally seen only in the last superior molar.

It is also evident that the quadritubercular molar is derived from the tritubercular by the addition of a lobe of the inner part of a cingulum of the

* American Naturalist, 1883, p. 1056; Science, 1883, p. 275.
† See American Naturalist, April, 1883, p. 407.

posterior base of the crown. Transitional states are seen in some of the Periptychidæ (*Anisonchus*), and in the sectorials of the Procyonidæ.

The tritubercular or triangular superior molar is associated with a corresponding form of the anterior part of the inferior molar. This kind of inferior molar* I have called the tubercular sectorial, and is very variable as to the degree of development of the sectorial cutting edge. The anterior triangle is formed by the connection by angle or crest, of the median and anterior internal crests with the anterior external. Its primitive form is seen in Didelphys, Pelycodus, Pantolambda and the Amblypoda generally; in Centetes and Talpa; and in its sectorial form, in Stypolophus and Oxyæna, etc.

The mechanical action of such teeth is as follows: Of course, it results from the form of the superior molars that the spaces between them are wedge-shaped, the apex external, the base opening to the palate. The base of the triangular section of the anterior part of the inferior molar is interior, and the apex exterior, and when the jaws are closed, this triangular prism exactly fits the space between the superior molars. The lower heel of the inferior molar receives the impact of the crown of the superior molar. Thus the oblique edges of the inferior triangle shear on the edges of two adjacent superior molars. The anterior parts of the inferior molars, and the superior molars, form an alternate dental series as distinguished from the prevalent opposed dentition of most mammalia. In so far it resembles the reptilian dentition.

This primitive dentition has been modified in two directions; viz., to form the grinding and the sectorial dentitions. As already remarked, the superior molars gradually acquire a posterior internal lobe, which produces the quadrituberculate type. This lobe, by opposing the anterior internal lobe of the next posterior inferior molar, precludes the entrance of the anterior triangle of the latter between the two superior molars. Hence we find in the types which possess quadritubercular superior molars, that the anterior triangle of the inferior molar is not elevated, if present, as for instance in Rhinoceros. It is, however, more frequently atrophied, and disappears, forming the inferior quadritubercular molar so well known.

On the other hand, as I have pointed out,† the anterior internal cusp of the triangle of the inferior molar may be more developed anteroposteriorly, giving the antero-internal edge of the triangle much greater obliquity than the postero-internal. In correspondence with this modification, the superior triangular molar loses its equilateral character by the more anterior position of its internal angle, thus elongating the posterior internal side of the crown. The latter thus fits the corresponding form of the triangle of the inferior molar, forming with it the shear of the sectorial tooth.

* See Report G. M. Wheeler, D. Chief of Engineers on Explor. Surv. W. 100th Mer. Vol. IV, pt. II; on the Creodonta.

† On the origin of the sectorial tooth of the Carnivora, American Naturalist, 1875.

In a former article, "On the Homologies of the Molar Teeth," etc., I traced the modifications of the superior and many of the inferior molars of the ungulate mammals to a parent quadrituberculate type. In a subsequent essay* I traced the origin of the inferior sectorial to a primitive five-tubercled, or "tubercular sectorial" type. Farther than this I did not go, and made no attempt to derive the few cases of triangular superior molars then known, nor the type of the superior sectorial. The revelations of the Puerco fauna show, that the superior molars of both ungulate and unguiculate mammalia have been derived from a tritubercular type; and that the inferior true molars of both have been derived from a "tubercular sectorial" type. Shall we look for the origin of the latter in a tritubercular tooth also, *i.e.*, tubercular sectorial without heel; and will the crowns of the true molars of the primitive mammals alternate with, instead of oppose each other? This is a probable result of future discovery.

On the Synchronous-Multiplex Telegraph. By Prof. Houston.

(*Read before the American Philosophical Society, December 7, 1883.*)

Prof. Houston said: "It is with considerable pleasure, Mr. President and gentlemen, that I am here this evening to call your attention to a discovery in electricity that appears to me to be of very great practical value to the world. The present decade has witnessed such marvelous progress in electrical inventions that many of us have perhaps been disposed to believe that but little new could reasonably be expected, but, unless I am greatly mistaken, the invention which I am about to describe to you, is greater even than that of the telephone.

"Before proceeding to the details of the invention of the synchronous-multiplex telegraph system of Mr. Patrick B. Delany, it will, perhaps, be best that your attention should first be called to some of the practical purposes for which it is applicable. Briefly stated, the value of this invention is to be found in the fact, that by its use the simultaneous transmission of numerous telegraphic dispatches over one and the same wire is readily accomplished. Hitherto, the only system that accomplished this, to any considerable extent, in actual practice, was the quadruplex system, and this, as you well know, is not only limited to the simultaneous transmission of four dispatches, but these are necessarily sent, two each, in opposite directions. You will, therefore, readily understand the great value of Mr. Delany's wonderful invention, when I inform you that not only can the number of simultaneously transmitted dispatches be very greatly increased, even indeed as far as seventy-two, but that all of them can be sent in the

*Journal Academy Natural Sciences, Philadelphia, March, 1875.

same direction, or any part in one direction and the remainder in the opposite direction.

"It would be difficult, on the eve of an important discovery like that we are discussing, to predict the extent and nature of the effect its practical introduction will have on the world at large; but this I think will appear evident, that the synchronous-multiplex telegraphic system will do for the most distant cities of our country, what the telephone has done for the inhabitants in the same city, or for those of neighboring cities, with, however, this difference, that in the case of the synchronous system, a permanent record is obtained of all dispatches sent or received, while in the telephonic system of transmission there is none.

"Without, however, seeking to look further into the future, let us pass to the descriptions of the details of this remarkable invention.

"The multiplex system differs radically from the quadruplex, which, as you are probably aware, is based on the balancing of resistances, or the differential method. The multiplex system, on the contrary, is based on the synchronous rotation of two trailing contact arms which are connected to the ends of the line, one at each end of the main line. Series of contacts, on the face of discs, swept by the trailing arms, are in electrical connection with the various operators that desire to use the line. By the rotation of the arms, the main line is brought successively into electrical contact with each of the operators, and carried from one to another, and again given back to each successively, so rapidly, that before any of them can realize that he has been disconnected from the line, it is again given to him, so that the line is at his disposal, to the same extent as if he alone was using it.

"The appliances whereby Mr. Delany maintains practically absolute synchronism in the revolving arms at each end of the line are of remarkable simplicity. A few of the contacts before referred to, as being placed on the face of the discs, are reserved for the maintenance of synchronism. Some of these contacts are connected to a battery and others to correcting devices at each end of the line, while others are left open or unconnected with anything. If the synchronous rotation of the two arms is maintained, no correcting impulses pass over the line, since, although one end thereof is in electrical connection with one of the batteries, the other end is on an unconnected segment, and the battery circuit being open, no current flows; should, however, the line at one end be brought in contact with a part of the disc, very slightly in advance of its position on the disc at the other end, then the battery is connected, and an electrical impulse flows over the line, and slows the rotation of the arm.

"The manner in which this correcting impulse is made a retarding one is as follows: the rotation of the trailing arm at each end of the line is maintained by an electric magnetic device, invented by LaCour, of Copenhagen, and termed by him a phonic-wheel. The rapidity of rotation of this wheel is dependent on the rapidity with which an electrical current traversing the coils of its electro-magnet, is made and broken.

"The makes and breaks in the circuit of the motor-magnet of the phonic-

wheel, are governed by the vibration of a tuning-fork, maintained in its vibration by the action of a voltaic battery. Since the rate of vibration of the fork governs the rate of rotation of the arm, it is only necessary to maintain the synchronous vibration of two forks, placed at each end of the line.

"Although the duration of vibration of a fork, like the oscillation of a pendulum, is sensibly the same for all amplitudes, provided the amplitude is very small, yet, as you are aware, the duration becomes longer, or the vibration slower, if the amplitude of the oscillation be very sensibly increased. Now the inventor obtains the requisite slowing of that fork's vibration, that is connected with the phonic-wheel that has gained on the other, by causing the electrical impulse that flows over the line to increase the strength of the electrical current that is traversing the battery circuit that is keeping it in vibration. This he accomplishes by cutting a resistance out of this circuit, and thus allowing more current to pass.

"In order to avoid the disturbance produced by the static charge, that is generally found in long lines, the inventor has provided a series of extra contacts, placed between each of the separate contacts that, at each end of the line, are connected to the transmitting or receiving instruments. These extra contacts are connected together and to the earth, so that when the line is disconnected from one instrument, it is put to the earth before it is given to the next instrument, and is thus completely freed from its static charge. These discharge contacts are absolutely necessary to the successful operation of the synchronous system, where the length of line employed is extended.

"Since the circuit of any operator is constantly made and broken, as often as the line is taken and again returned to him, the use of an ordinary Morse relay would be inapplicable in the practice of this system, since all the impulses (a number of which make up a single character, as well as the characters sent into the line from the transmitting key of the operator connected) would be recorded. In order to avoid this confusion the transmission battery is split and grounded in the middle, and polarized relays substituted for the ordinary instruments. Since these relays respond, not to makes and breaks in the circuit, but to changes of polarity only, the receiving instruments are influenced only by the characters sent by the operators, and not by the successive makes and breaks.

"The successful solution of the problem of maintaining synchronism by the methods I have explained, render many things possible that without it would have been impossible. Among these I may mention the various applications of fac-similies, and autographic telegraphs. Without attempting to go into the details of their application, it will suffice to say that the probable applications of Mr. Delany's system are so numerous and important, as to entitle him to a very high rank among the world's inventors."

Stated Meeting, December 21, 1883.

Present, 8 members.

President, Mr. FRALEY, in the Chair.

A letter from Bishop de Schweinitz, dated Bethlehem, Dec. 12th, enclosing a certified extract from the minutes of the "Board of Directors of the *Society of the United Brethren for Propagating the Gospel among the Heathen*," was read, and, on motion, it was

Resolved, That the Curators be authorized and requested to return the Zeisberger and Perlæus documents to their proper owners, and take a receipt for the same.

Donations for the Library were received from the Society at Riga, the Royal Society of Victoria, Royal Academy and Prof. Paul Albrecht of Brussels; Geographical Society of Paris and Bordeaux; the Institute of France; Royal Academy at Madrid; Meteorological, Zoölogical, and Royal Asiatic Societies at London; Cambridge Museum of Comparative Zoölogy; American Oriental Society; Prof. Oswald Seidensticker, Prof. Edwin J. Houston, and Mr. Henry Phillips, Jr.; Mr. Wm. Hand Browne of Baltimore, American Journal of Mathematics; United States National Museum; J. L. Smithmeyer; Ohio Mechanics' Institute of Cincinnati; and the American Antiquarian and Oriental Journal.

Also framed phototypes of the Smithsonian Institution Building, and of Henry W. Longfellow, presented by Mr. F. Gutekunst of Philadelphia.

The death of Dr. Thomas S. Kirkbride, Superintendent of the Pennsylvania Hospital for the Insane, in West Philadelphia, on the 17th of December, aged 74, was announced by the President, who was requested to appoint a member of the Society to prepare an obituary notice of the deceased.

A communication for the Magellanic Premium was received through the President from "Time is Money," consisting of a description and model of "A Universal Time-piece." Referred to the Board of Officers and Council.

PROC. AMER. PHILOS. SOC. XXI. 114. 2P. PRINTED JANUARY 28, 1884.

Prof. Rothrock read a paper entitled: "The microscopic examination of timber with regard to its strength; a contribution from the Eli K. Price Botanical Laboratory of the University of Pennsylvania, by Frank M. Day." Remarks were made on the interesting subject of the paper by Dr. Brinton, Mr. Ingham and Mr. Price, and the Treasurer was authorized to pay for necessary illustrations. (See page 333.)

Mr. Phillips communicated "A note respecting the correct name of the last letter of the English Alphabet?"

Mr. Lesley exhibited a small copper-plate map of Pennsylvania which he had colored geologically according to the system of Major J. W. Powell, Director of the United States Geological Survey, as a contribution to a general map of the United States now in preparation at Washington for illustrating the coloration adopted by Major Powell, and intended for presentation at the Congress of Geologists to meet at Berlin in 1884.

Dr. Allen read a paper "On a case of human congenital malformation," and exhibited two photographic views of the subject.

The reading of pending nominations was postponed.

Mr. Phillips reported that the Curators were consulting with Mr. Rothermel respecting the oil paintings of the Society.

The Report of the Finance Committee was received.

The annual appropriations for 1884 recommended therein were passed.

And the meeting was adjourned.

A Note respecting the Correct Name of the Last Letter of the English Alphabet. By Henry Phillips, Jr.

(Read before the American Philosophical Society, December 21, 1883.)

A dislike of what seemed to be a growing evil, one which had greatly increased within the past twenty years, the misnomer of the last letter of the English alphabet, by which it was called *zee* instead of *zed*, led me to investigate so far as the material was accessible to me into the origin of this usage, and into the authorities by which it was countenanced. I have

accordingly consulted various English Dictionaries, of which I subjoin a list, from the year 1656 to the present time, with the following results, viz. :

1. That the name *zee* for *zed* (or *izzard*,* as the letter was formerly termed), seems to have made its appearance in the first edition of Webster's Dictionary of the English Language, published in 1828. But in the editions of that work, published respectively in 1860, 1864 and 1869, and possibly earlier, *zed* is given as the *English* name of this letter, while *zee* is the American. It is noteworthy that Webster seems to have no authority for his change of nomenclature, nor can I find in his published writings any reason therefor, unless it be perhaps that some petty local peculiarity in the small country towns of New England led him to believe that no other pronunciation could be a correct one. In a Dictionary of the English Language, "by an American Gentleman," published in Burlington, New Jersey, in 1813, the name is given as *zed*.

As conclusive of former usage, the passage in *Lear*, Act II, Scene 2, may be quoted :

"Oh thou Zed! thou unnecessary letter."

I have not been able to find in Ben. Johnson's English Grammar any usage bearing on this point.

2. The analogy with the similar letter *z* of the German alphabet, of which the name is *tsett*, certainly deserves respect.

Freeman, in his impressions of the United States (p. 84), writes : "I think I see another instance of the schoolmaster in the name which in some parts of America is given to the last letter of the alphabet. This in New England is always *zee;* in the South, it is *zed*, while Pennsylvania seems to halt between the two opinions. Now *Zed* is a very strange name. * * * Does it come from the old form *izzard* * * which I was delighted to find remembered in America. * * * But *zee* is clearly a schoolmaster's desire to get rid of the strange sounding *zed*, and to make *z* follow the analogy of (some) other letters. But this analogy is wrong; *z* ought not to follow the analogy of *b*, *d*, *t*, but *l*, *m*, *n*, *r*, and above all of its brother *s*, so that if we are not to have *zed*, the name should clearly be *ez*."

But there seems no necessity or reason why any change whatever should take place in this respect.

3. From the forty-seven dictionaries which I have consulted I obtain the following result :

Name of the letter given as *zed*	24
" given as *zee* (none earlier than 1828, and all American)	3
" of letter not given at all	20
	47

* Nares' Orthoepy, I, 138, London, 1792, speaks of the letter as *izzard;* than which, however, he considers that the name *zad* would be "more elegant and proper."

LIST OF DICTIONARIES CONSULTED.

1656.	T. B.,	London,	not given.
1678.	Phillips, World of Words,	"	not given.
1691.	Sewell, Dutch and English,		not given.
1720.	Phillips,		not given.
1736.	Bailey,	London,	not given.
1749.	Junius,	Oxford,	not given.
1755.	Johnson,	London,	zed.
1757.	Serenius, English and Swedish,	Nykoping,	zed.
1771.	Skinner,	London,	not given.
1775.	Ash,	"	not given.
1780.	Sheridan,	"	not given.
1782.	Cox,	"	zed.
1783.	Kendrick,	"	not given.
1783.	Barclay,	"	not given.
1784.	Nare's Orthoepy,	"	zed.
1785.	Johnson,	Dublin,	not given.
1789.	Sheridan,	Philadelphia,	not given.
1795.	Ash,	London,	zed.
1797.	Walker,	"	zed.
1804.	Jones,	"	zed.
1805.	Perry,	"	not given.
1806.	Johnson,	"	zed.
1813.	Barclay,	Bungay,	not given.
1813.	"An American Gentleman,"	Burlington, N. J.,	zed.
1818.	Johnson,	Philadelphia,	zed.
1819.	Johnson.	"	zed.
1824.	Walker's Rhyming Dictionary,	London,	zed.
1828.	Webster, first edition.		zee.
1835.	Booth,	London.	not given.
1835.	French, German and English,	Leipzig,	zed.
1841.	Fleming and Tibbin, French and English,		zed.
1845.	Knowles,	London.	not given.
1846.	Bolles, Phonographic Pronouncing,	New London,	zee.
1851.	Richardson.	Philadelphia,	not given,
1853.	Todd, Johnson and Walker,	"	zed.
1853.	Millhouse, Italian and English,	Milan,	zed.
1856.	Ogilvie's Imperial,	London,	zed.
1857.	Nare's Glossary,	"	zed.
1860.	Worcester,	England, zed; in the U. S. zee.	
1860.	Johnson,	London (Bohn),	zed.
1862.	Reiff, Russian, French, German and English,		zed.
1863.	Wilson, French and English,	"	zed.
1864.	Webster,	Springfield,	zed (also izzard).
1866.	Grieb, German and English,	Philadelphia,	zed.
1869.	Webster,	Springfield,	zed.
1880.	Webster.	"	not given.
1882.	Skeat,	Oxford,	not given.

This brief note is simply intended as a suggestion to call the matter to the attention of those better qualified to consider it than myself.

NOTE.—Since the foregoing went to press I have found in reading Taylor's History of the Alphabet (London, 1883), the following matter bearing upon this subject, and confirmatory of my views:

"The name *zed* is a survival of the early *tsadde*. (Vol. II, p. 137). * * *

Z was the last introduced of the letters of the Roman alphabet. * * * It crept into English during the fifteenth century from the French, and in use is now pretty nearly restricted to foreign loan-words * * * *çedilla* means *little zed: zediglia* is the diminutive for *zeticula.*" p. 138.

The Microscopic Examination of Timber with regard to its Strength. A Contribution from the Eli K. Price Botanical Laboratory of the University of Pennsylvania. By Frank M. Day.

(*Read before the American Philosophical Society, December 21, 1883.*)

The valuable paper of Dr. J. T. Rothrock upon "Some Microscopic Distinctions between Good and Bad Timber of the Same Species," recently read before the American Philosophical Society, has opened a broad field for original investigation. The question there suggested as to the possibility of approximately determining the strength of timber by microscopic examination (involving as it does the question of the "differences in the strength of wood due to the molecular differences in the structure of the fibre") is one that can be answered only after the most extended and carefully conducted investigation.

As long as we confine ourselves to the examination of various specimens of the same species the task of distinguishing the good pieces from the bad, and of roughly predicting the relative strains which they will resist, is comparatively easy.*

Plate I showing transverse sections of two pieces of Rock Elm (*Ulmus racemosa* Thomas), furnishes illustrations of the general differences between good and bad wood of the same species. The upper figure is a section of the wood used by a well-known firm in their highest grade of hubs; the lower is a section of wood which they declare to be practically worthless. It is evident from a glance at these drawings that the good differs from the bad, in 1st, The much smaller area occupied by ducts; 2d, The smaller bore and consequently thicker walls of the woody fibres; 3d, The more compact arrangement of the woody fibres, giving them a polygonal rather than a circular outline; 4th, The much greater annual growth. These are the elements which it is but reasonable to suppose would give strength to the wood. They are further those which are found to do so in the great majority of cases.

The strength of the cellulose of which the wood is composed, is, in various species and under various conditions, by no means the same. For example, Buttonwood (*Platanus occidentalus* L.) rapidly loses the greater part of its strength, by a natural process which the woodsmen call "doating," the only indication of which is a bleaching of the tissues. Hence any statements as to the strength of timber, made from an examination of the structure alone are open to question.

* This it will be urged can be done by the practical eye without the aid of the microscope, but it must be remembered that the entire investigation of the subject is, at its present stage, of theoretical rather than practical interest.

We are, however, able to leave this uncertain element out of consideration when we turn our attention to the following experiments upon the transverse strength of the coniferous woods, the results of which point to an almost identical value for the strength element of the cellulose in the several pieces tested. Each piece was exactly one-and-a-half inches square by two feet nine inches long, and rested upon rounded edges at a distance of two feet six inches apart. The pressure was gradually applied at a point half way between the supports, and the deflection was taken at each hundred pounds.

Plate II shows, side by side, transverse sections of three pieces thus tested. The detail of the experiments are exhibited in the following table:

Letter of Experiment.	NAME OF WOOD.	Specific Gravity.	Greatest Strain	Effect of Greatest Strain.	Deflection with Greatest Strain	Deflection with 500 lbs.	Length of Woody Fibre.	Average Annual Growth.
			Lbs.		In.	In.	In.	In.
H	Yellow Pine (*Pinus* sp?).....	.817	2000	Broke.	.84	.20	.165	.125
L	White Pine (*Pinus Strobus* L.).....	.415	1190	Broke.	1.21	.43	.169	.033
E	Hemlock (*Abies Canadensis* Michx.).	.422	1000	Broke.	.98	.36	.176	.071

These results, taken in connection with an examination of the sections, indicate a great probability that in the coniferous woods the strength depends chiefly upon the ratio of the number of thickened autumn-fibres to the total number of fibres formed during the year, becoming greater the greater the number of thickened fibres. Thus it is seen that in *H*, by far the strongest of the three pieces tested, the thick-walled fibres occupy almost half the year's growth, while in *E* they form a mere strip at the end of the growth. In connection with this statement it may be well to remark that the absolute breadth of the annual growth in the coniferous woods does not seem to be as important an element in the problem of strength as in the so-called "hard-woods" (*Angiosperms*). The reason of this is the absence of the ducts which in the "hard woods" are formed, as a rule, in the early part of the annual growth. After this the solid wood is formed. Hence, the value in them, other things being equal, of a large annual growth.

The ease with which the results of the tests upon the coniferous woods are explained gives place to the greatest difficulty in the case of the hard woods. Important factors in this case, and ones which we have not been called upon to consider in the coniferous woods, are, 1st, the weakness due to a greater or less abundance of ducts, and second, the strength added by more or less highly developed medullary rays.* The following table contains the results of eight experiments as to transverse strength made in exactly the same manner as described in the previous case. The pieces of timber were in all cases carefully selected and accurately dressed. They

* The medullary rays being much less conspicuous in the Coniferæ.

were free from shakes and all other imperfections that might tend to vitiate the results:

Letter of Experiment.	NAME OF WOOD.	Specific Gravity.	Greatest Strain.	Effect of Greatest Strain.	Deflection of Greatest Strain.	Deflection with 500 lbs.	Length of Woody Fibre.	Exterior Diameter of Woody Fibre.	Interior Diameter of Woody Fibre.	Ratio of Exterior to Interior Diameter.	Duct Area.	Average Annual Growth.
			lbs.			in.	in.	in.	in.		sq in	in.
A	Hickory (Carya porcina, Nutt.)	.609	1600	Broke.	1.52	.17	.057	.000811	.00036	2.25	.177	.040
B	Hickory (Carya porcina, Nutt.)	.966	1400	No sign of Breaking.	4.59	.22	.048	.000576	.00012	4.82	.029	.125
D	White Oak (Quercus alba, L.)	.706	1500	Broke.	1.08	.40	.056	.000696	.000312	2.23	.189	.047
C	White Oak (Quercus alba, L.)	.825	1200	No sign of Breaking.*	4.56	.46	.055	.000699	.000216	3.22	.048	.107
G	White Ash (Fraxinus Americana, L.)	.615	1750	Broke.	1.08	.29	.047	.000904	.000488	1.85	.222	.052
I	Red Ash (Fraxinus pubescens, Lam.)	669	1600	Broke.	1.28	.36	.059	.000888	.000512	1.71	.253	.055
J	Chestnut (Castanea vesca, L.)	.441	900	Broke.	.55	.49	.042	.00104	.000784	1.33	.210	.066
K	Tulip Poplar (Liriodendron Tulipifera, L.)	.414	1200	Broke.	.94	.24	.033	.001176	.000768	1.53	.333	.051

* Stick bent to support. Hence could bend no further.

Each of the numbers given in the columns headed, Length of Woody Fibre, Exterior Diameter of Woody Fibre and Interior Diameter of Woody Fibre is the average of twenty micrometric measurements. The numbers in the column headed Duct Area represent the area occupied by ducts in one square inch of transverse section. Each of the results there given is the average of planimeter measurement of three camera lucida drawings taken at various parts of a section.

The results of the first four of the above experiments may be summed up thus : *A* and *D stiff* hickory and white oak had small annual growth, moderately large duct area and moderately thick fibre walls ; whereas *B* and *C, elastic* hickory and white oak, had moderately large annual growth, small duct area and thick fibre walls. Whether the general difference between elastic and stiff timber is chiefly due to a difference in the character of the cellulose, or whether it is chiefly due to a difference of cell structure is a question that would require a much more extended series of experiments than the above to settle finally. The results given, though too few in number to be of great value, point to the latter view of the case ; while the fact that the same piece of wood will, at various ages, exhibit various degrees of elasticity, inclines us to the former. The experiments *G*, *I*, *J* and *K* show the difficulty of comparing woods of different species. For instance, the pieces *G* and *J* had almost the same annual growth, duct area and fibre thickness. Yet they broke with strains of respectively 1730 lbs. and 900 lbs. An observation that brings out more clearly than before the fact that *differences* of *strength* in woods of *different species* are largely due to *differences* in the *cellulose*.

The measurements of length of woody fibre given in this and in the table of the results of experiments upon the coniferous woods, furnish excellent proof of the correctness of the statement made by Dr. Rothrock, that the relation between the absolute length of fibre and the strength of timber is a very slight one.

The importance of the medullary ray as a strength giving element, though suggested, has not, heretofore, been insisted upon with sufficient positiveness. The following experiments, undertaken with reference to this point, show that in woods such as Oak and Buttonwood, in which the rays are highly developed, a large part of the strength is due to their presence. From cubes of wood, the edges of which measured six inches, plates six inches square and one inch thick were cut in a direction transverse to the woody fibres. From these, pieces of a shape suitable for testing in a cement testing machine were cut, in such a manner that half of the pieces had the medullary rays running in the direction in which the tension was applied, and half of them in a direction perpendicular to this. In each the area subject to strain was one square inch. The result gives, of course, the lateral adhesion of the fibres, with and without the strength added by the medullary rays.

	Live Oak, (*Quercus virens*, Ait.)	Red Oak, (probably either *Q. rubra* or *Q. palustris*.)
	Lbs.	Lbs.
The five pieces tested with the rays running in the direction of the tension broke at..	1265 900 1250 960 1225	440 490 480 425 470
Average.....	1120	461
The five pieces tested with the rays running perpendicular to the direction of tension broke at.....	500 710 480 590 680	245 195 155 190 160
Average.....	592	189

The surprising fact will be observed that in the Live Oak the force required to overcome the lateral adhesion of the fibres when reinforced by medullary rays is almost, and in the Red Oak more than twice that required when not so reinforced. Similar experiments upon Buttonwood (*Platanus occidentalis*, L.) would probably show an equal, if not greater, difference. While Hemlock, Pine, Tulip-Poplar or other woods with weak rays, it is but reasonable to expect, would show but slight differences in the two directions.

In view of the above results it is easy to see that resistance to splitting, although usually ascribed to "crookedness of grain," is also in a large measure due to the binding action of the rays. Where, however, we have both of these qualities present, we find a wood admirably adapted for certain purposes, as for example the manufacture of hubs. Hence it is that Rock Elm (*Ulmus racemosa*) and Black Gum or Tupelo (*Nyssa multiflora*, Wang.), in both of which abundant rays are found coupled with great contortion of fibres, are much in demand by hub makers.

In Lignum Vitæ (*Guaiacum officinale*) the crossing of the fibres of different layers is very apparent, and in a specimen of Black Gum, fibres were found which deviated from the vertical as much as ten times their breadth in their own length.

Plates III and IV are given as illustrations of the statement concerning the resistance to splitting or wedging made above. The upper half of Plate III shows a transverse section of Buttonwood, enlarged 125 times. The drawing is made from the wood of the butt of a tree which portion presented such great resistance to wedging that it was finally reduced to manageable size by the use of gunpowder. In it are seen the abundance

of ducts and great size of medullary ray characteristic of this wood. Below it is placed a transverse section of Tulip-Poplar (same amplification), a wood which splits as easily as Pine. In it the abundance of ducts and weakness of medullary rays are shown. Plate IV gives the same woods, with the same amplification in tangential section, thus cutting the rays transversely and showing the contortion of the fibres in Buttonwood and their straightness in Tulip-Poplar.

To Dr. J. T. Rothrock, for his kind assistance and advice during the preparation of the present article, the writer wishes to express his sincerest thanks. Thanks are also due to Mr. Simmonds, of the University, for his careful preparation of the specimens tested, and to Messrs. Riehlé Bros., upon whose machines the work of testing was performed.

Explanation of Illustrations.

The drawings were all made by the aid of the camera lucida.
In Plate II the amplification is 75 diameters.
In Plate I, III and IV the amplification is 125 diameters.

Plate I, *a*, *Ulmus racemosa.* (Good.)
b, *Ulmus racemosa.* (Bad.)

Plate II, *a*, *Pinus* (sp. ?)
b, *Abies Canadensis.*
c, *Pinus Strobus.*

Plate III, *a*, *Platanus occidentalis*, } Transverse sections.
b, *Liriodendron Tulipifera*, }

Plate IV, *a*, *Platanus occidentalis*, } Tangential sections
b, *Liriodendron Tulipifera*, }

In all the illustrations the following lettering is used:
W F—Woody Fibre.
D—Duct.
M R—Medullary Ray.

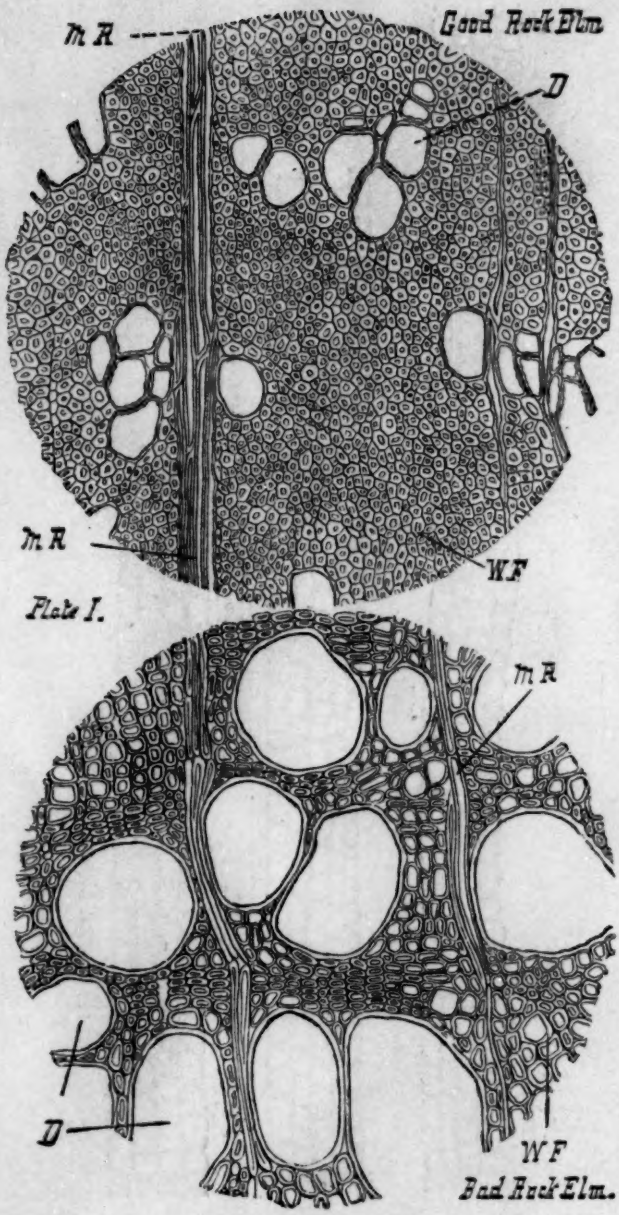
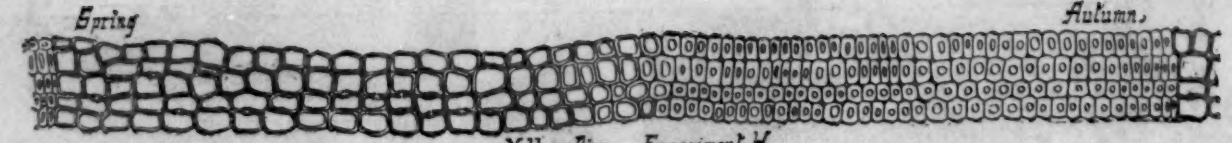
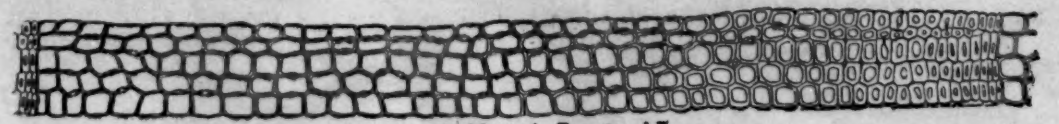


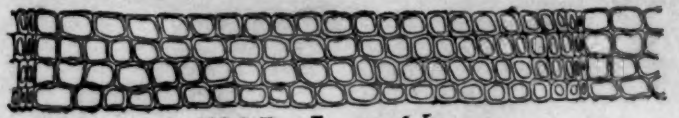
Plate I.



Yellow Pine. Experiment H.



Hemlock. Experiment E.



White Pine. Experiment L

Plate II.

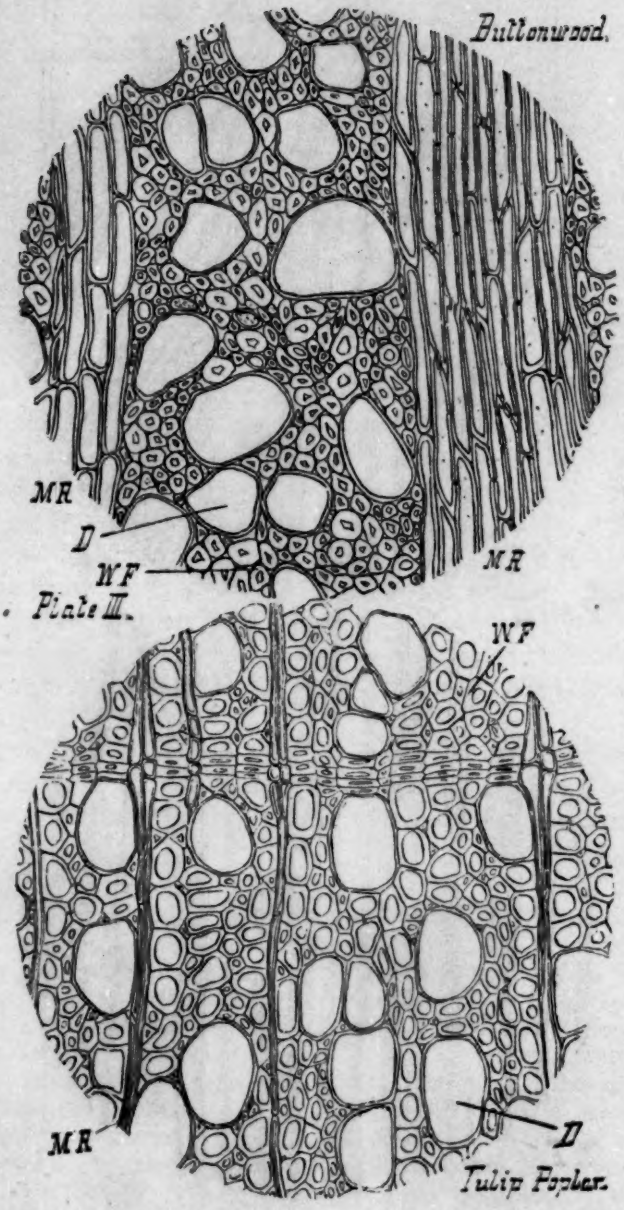


Plate III.

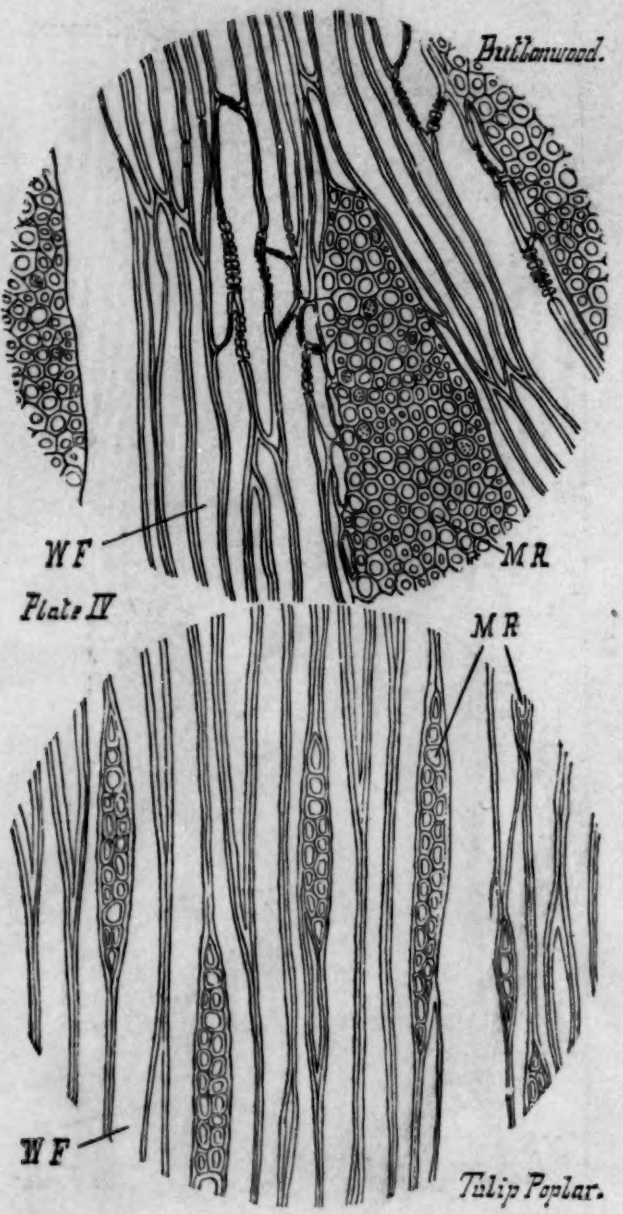


Plate IV

Stated Meeting, January 4, 1884.

Present, 7 members.

President, Mr. FRALEY, in the Chair.

Donations for the Library were received from Captain R. C. Temple, Allahabad; MM. August Berger and Fried. Pressel, Ulm; Prof. Paul Albrecht, Brussels; the Geological Commercial Society, Bordeaux; the Geographical Society and M. Luciano Cordeira, of Lisbon; the Revista Euskara; Revue Politique; Mr. H. M. Stanley; Mr. W. Marriott; Mr. John Hampden; London Nature; Meteorological Society; Royal Astronomical Society, Victoria Institute; Kew Observatory; Royal Geological Society of Cornwall; Mr. F. B. Hough, of Concord, New Hampshire; the Essex Institute; B. N. H. S.; Science Record; Meteorological Observatory at New York; Philadelphia Library Company, Franklin Institute, Mr. Henry Phillips, Jr., United States Fish Commission and United States National Museum.

The death of Sven Nillson, at Lund, November 30, 1883 aged 96 years, 8 months, 22 days, was announced.

The death of General Thomas Leiper Kane, at Philadelphia, December 26, 1883, aged 61 years, 11 months, was announced by Mr. J. S. Price.

The death of General Andrew A. Humphreys, at Washington, December 27, 1883, aged 73 years, was announced by Mr. Fraley, who was, on motion, authorized to select members of the Society to prepare notices of General Kane and General Humphreys.

Mr. Lesley offered to the inspection of the members a photographic print of one of Mr. George Simpson's beautiful drawings of Mr. Mansfield's cannel coal shale specimens, on which was exhibited a nearly perfect specimen of *Dolichopterus Mansfieldi* C. E. Hall (see Proceedings American Philosophical Society, Volume XVI, page 621, 1877), lying across a mass of broken ferns and stems, *Pecopteris*, *Neuropteris*, *Annularia*, *Sigillaria*, &c. Twenty-five figures of Eurypterids, in whole or in part, with enlargements of scales, &c., will be published by the Second Geographical Survey, with the three plates of similar forms rom Warren county, drawn and described by Mr. C. E. Beecher.

He exhibited also a *quartz pebble*, with coal adhering to its sides, about the size of a goose egg, found in the floor of Mr. Mansfield's *Cannel coal bed*, at his mines near Cannelton, in Beaver county, Pennsylvania. Four such had been found at different times in the progress of mining this bed. Similar finds have been made in other coal fields in America and in Europe. One very large rock of limestone in the body of a coal bed in Fayette county, Pennsylvania, was reported by Prof. J. J. Stevenson. Such events could only have taken place beneath very slowly running water bearing along upland trees with stones attached to their roots, and dropping these stones one by one into the marsh vegetation through which the water moved.

Mr. Lesley communicated a note, or suggestion, in mythological studies, respecting the original meaning of the animal ideograph of the god *Set*.

Dr. Brinton, Mr. Phillips and Mr. Lesley were appointed a Committee to examine the Mexican manuscripts belonging to the Society, now on deposit with the Academy of Natural Sciences of Philadelphia, to report on the propriety of preparing any of them for publication, and with power to reclaim the same.

Mr. Lesley was nominated Librarian.

The Report of the Judges of the Annual Election was read, by which the following officers were declared duly elected for the ensuing year, 1884:

President,

Frederick Fraley.

Vice-Presidents,

Eli K. Price, E. Otis Kendall, Pliny E. Chase.

Secretaries,

Geo. F. Barker, Daniel G. Brinton, Henry Phillips, Jr., J. P. Lesley.

Counsellors for three years,

Daniel G. Goodwin, W. S. W. Ruschenberger, Henry Winsor, Wm. A. Ingham.

Curators,

Geo. H. Horn, Charles E. Ames, Philip H. Law.

Treasurer,

J. Sergeant Price.

And the meeting was adjourned.

be adjudged by them to the author of the best discovery, or most useful invention, relating to Navigation, Astronomy, or Natural Philosophy (mere natural history only excepted); and the Society having accepted of the above donation, they hereby publish the conditions, prescribed by the donor and agreed to by the Society, upon which the said annual premiums will be awarded.

CONDITIONS OF THE MAGELLANIC PREMIUM.

1. The candidate shall send his discovery, invention or improvement, addressed to the President, or one of the Vice-Presidents of the Society, free of postage or other charges; and shall distinguish his performance by some motto, device or other signature, at his pleasure. Together with his discovery, invention, or improvement, he shall also send a sealed letter containing the same motto, device or signature, and subscribed with the real name and place of residence of the author.

2. Persons of any nation, sect or denomination whatever, shall be admitted as candidates for this premium.

3. No discovery, invention or improvement shall be entitled to this premium, which hath been already published, or for which the author hath been publicly rewarded elsewhere.

4. The candidate shall communicate his discovery, invention or improvement, either in the English, French, German, or Latin language.

5. All such communications shall be publicly read or exhibited to the Society at some stated meeting, not less than one month previous to the day of adjudication, and shall at all times be open to the inspection of such members as shall desire it. But no member shall carry home with him the communication, description, or model, except the officer to whom it shall be entrusted; nor shall such officer part with the same out of his custody, without a special order of the Society for that purpose.

6. The Society, having previously referred the several communications from candidates for the premium, then depending, to the consideration of the twelve Councillors and other officers of the Society, and having received the report thereon, shall, at one of their stated meetings in the month of December, annually, after the expiration of this current year (of the time and place, together with the particular occasion of which meeting due notice shall be previously given by public advertisement) proceed to final adjudication of the said premium; and, after due consideration had, a vote shall first be taken on this question, viz.: Whether any of the communications then under inspection be worthy of the proposed premium? If this question be determined in the negative, the whole business shall be deferred till another year; but if in the affirmative, the Society shall proceed to determine by ballot, given by the members at large, the discovery, invention or improvement most useful and worthy; and that discovery, invention or improvement which shall be found to have a majority of concurring votes in its favor shall be successful; and then, and not till then, the sealed letter accompanying the crowned performance shall be opened, and the name of the author announced as the person entitled to the said premium.

7. No member of the Society who is a candidate for the premium then

depending, or who hath not previously declared to the Society that he has considered and weighed, according to the best of his judgment, the comparative merits of the several claims then under consideration, shall sit in judgment, or give his vote in awarding the said premium.

8. A full account of the crowned subject shall be published by the Society, as soon as may be after the adjudication, either in a separate publication, or in the next succeeding volume of their Transactions, or in both.

9. The unsuccessful performances shall remain under consideration, and their authors be considered as candidates for the premium for five years next succeeding the time of their presentment; except such performances as their authors may, in the meantime, think fit to withdraw. And the Society shall annually publish an abstract of the titles, object, or subject matter of the communications, so under consideration; such only excepted as the Society shall think not worthy of public notice.

10. The letters containing the names of authors whose performances shall be rejected, or which shall be found unsuccessful after a trial of five years, shall be burnt before the Society, without breaking the seals.

11. In case there should be a failure, in any year, of any communication worthy of the proposed premium, there will then be two premiums to be awarded the next year. But no accumulation of premiums shall entitle the author to more than one premium for any one discovery, invention or improvement.

12. The premium shall consist of an oval plate of solid standard gold of the value of ten guineas. On one side thereof shall be neatly engraved a short Latin motto suited to the occasion, together with the words: "The Premium of John Hyacinth de Magellan, of London, established in the year 1786:" and on the other side of the plate shall be engraved these words: "Awarded by the A. P. S. for the discovery of———A. D.———." And the seal of the Society shall be annexed to the medal by a ribbon passing through a small hole at the lower edge thereof.

SECTION 2. The Magellanic fund of two hundred guineas shall be considered as ten hundred and fifty dollars, and shall be invested separately from other funds belonging to or under the care of the Society, and a separate and distinct account of it shall be kept by the Treasurer.

The said fund shall be credited with the sum of one hundred dollars, to represent the two premiums for which the Society is now liable.

The Treasurer shall credit the said fund with the interest received on the investment thereof, and, if any surplus of said interest shall remain after providing for the premiums which may then be demandable, said surplus shall be used by the Society for making publication of the terms of the said premium, and for the addition, to the said premium, of such amount as the Society may from time to time think suitable, or for the institution of other premiums.

The Treasurer shall, at the first stated meeting of the Society in the month of December, annually, make a report of the state of said fund and of the investment thereof.